Gas Journal

DECEMBER 5, 1934

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Editorial Notes

Assessing Gas-Making Results

"THE assessment of carbonizing plant is of undoubted value. Correlation of the results obtained at one place under the conditions there ruling with the results at another place would be of value to the constructor who is endeavouring to discover the effect of some alteration in design that may have been made with a view to improvement of his plant, and it would equally interest buyers, who have to interpret rival, and possibly conflicting, claims." The foregoing is quoted from an article on later pages by Dr. G. E. Foxwell, who discusses the variation of the behaviour of carbonizing plants. Having devoted attention to one of these variables—the character of the coal as charged into the retort or oven—he arrives at the doleful conclusion that the possibilities for local variation are so great that it is impossible to rely upon a comparison of the working results of two plants operating under different conditions as any criterion of the work of the construction and design of the carbonizing installation itself. This pessimistic view, however, does not apply to *gas-making* results.

We believe that much of the future prosperity of the Gas Industry will depend upon recognition of a single factor in the gas-making process. This factor is the make of therms of the enriching hydrocarbons and their calorific value. This is the true index to gas-making efficiency, and without question in this direction lie possibilities of improvement. Make of therms per ton of coal so often quoted as indicative of the excellent working of plant does in fact mean very little. Mr. X., for example, may be making, say, 88 therms per ton of coal carbonized, while Mr. Y. is producing only 80. Yet it may well be, and often is, the case that Mr. Y. is operating at far greater efficiency than Mr. X. Nor is vast throughput of coal through a setting in itself a criterion of gas-making efficiency. We suggest that gas engineers would be well advised to pay the closest attention to the yield of enriching hydrocarbons, which we are convinced constitutes the keystone of the gas-making process.

We have mentioned this point before in these columns, but not until a few days ago did we know how, in a simple manner, to arrive at the hydrocarbon enrichment value being obtained in different plants, whether on the horizontal, the intermittent vertical, or the continuous vertical system, or in coke ovens. The solution, however, we believe, has been found by Dr. S. Pexton, of the Gas Light and Coke Company. Continuing the work of Hollings as described in the paper on "Chemistry of Gas-Making" at the meeting of the Institution of Gas Engineers in June, 1928, he has evolved a delightfully simple formula which we feel sure will have far-reaching results on the construction of the various types of gas-making plant and on the quality and therefore the market value of the bye-products of carbonization as carried out in the Gas Industry. His equation, he explained at a Joint Meeting of the North-Western Section of the Institute of Fuel and the Manchester District Association of Gas Engineers, is applicable to all types of plant using any type of coal, and whether steaming is or is not carried out. The latter is a point which we would strongly emphasize. We would also make it clear that Dr. Pexton's present paper is concerned not with the thermal requirements of heating a setting, but with the gas-making process as such.

Pexton's Yardstick

PEXTON'S YARDSTICK is as follows:

$$E = \frac{V}{100{,}000}\left[H - 318\left(1 - \frac{N}{100}\right)\right]$$

where E = Hydrocarbon enrichment value (therms).
V = Volume of the purified gas (c.ft. per ton coal).
H = Calorific value of the purified gas (B.Th.U. per c.ft.).
N = Percentage inerts (*i.e.*, $CO_2 + O_2 + N_2$) in the purified gas.

In the absence of coal gas leakage out of the retorts, the value of "E," the Hydrocarbon Enrichment Value, is an index of the cracking conditions within the retort, and, hence, within the range of calorific values of gas normally supplied, an index of gas-making efficiency. An increase in the value of "E" means an approach towards optimum cracking conditions. As this value decreases it indicates one of two things—either under-cracking due to insufficient heat, or over-cracking due to excess of heat or leakage of gas from the retort. With under-cracking we get a gas of high calorific value but of small volume, and of high specific gravity, and the yield of tar—with characteristics of low-temperature tar and reduced market value—is high. With over-cracking, on the other hand, we have a low tar yield, a high volume of low calorific value gas of low specific

gravity, and all the troubles of naphthalene, and so on, which are part and parcel of over-cracking. There is also another point about over-cracking which deserves consideration, and that is the deposition on the surface of the coke of highly unreactive carbon which renders the coke more difficult to ignite.

The best value of " E " means that water gas dilution of the gas produced can be carried out to the greatest advantage, and it allows the best use to be made of benzole recovery. " E " enables the results of plants to be compared on a true basis. It brings a searchlight to bear on factors of working hitherto obscure. It explains away many a boosted result of plant operation, and it can be applied with ease. We are convinced that its application will eventually lower the cost of gas production to a marked degree. As we have said, it is applicable to steaming and non-steaming conditions, for the water gas produced during steaming is given the calorific value of water gas—namely, 318 B.Th.U. per c.ft.—after inerts are taken into account. " E " fulfils another purpose. Take the case of a works where there are carbonizing plant and carburetted water gas plant. Here its application clears the mind in making the necessary adjustments in respect of benzole recovery. Again, " E " will indicate the value of gas making coals in a direct and certain manner.

Some of our readers may ask, Where is the snag? So far, at any rate, we cannot find one, and we believe that the Gas Industry will have cause to be grateful to the Gas Light and Coke Company and to Dr. Pexton for penetrating by scientific method some of the complexities of gas making.

Electricity (Supply) Bill

THE House of Commons devoted the evening of the Royal Marriage to the Second Reading of the Government's Electricity (Supply) Bill, or, as it was humorously but aptly described, " The Central Electricity Board (Extension of Powers) Bill."

There is a great deal of mystery about this Bill, and the mystery adheres not only to its four most complicated Clauses, but more particularly to the persistence with which the Government has implemented its progress. What ails the electricity industry that the Government, like a careful nurse, must for ever be lingering responsive to its softest call?

We commend the study of the history of this Bill to those who have in the past failed to appreciate the feeling of injustice which the attitude of various Governments to the electricity industry has evoked in the minds of many of the leaders of our own Industry. Let us briefly outline the circumstances which led to the introduction of this Bill. The Taunton Corporation desired to enter into an agreement with the Central Electricity Board, but serious doubts were entertained as to whether such an agreement would be legal. The Corporation therefore promoted a Private Bill to clarify the position. The Bill had not proceeded far upon its passage to the Statute Book when the Government announced that they proposed themselves to introduce a Public Bill (which, of course, would have behind it the whole weight of the Government) dealing with the position, and thereby relieve the Taunton Corporation from the necessity of continuing with the promotion of its private measure.

The Government Bill was introduced and passed through all its stages in the House of Lords last May, but, owing to unexpected opposition, failed to pass through the House of Commons before the close of the Parliamentary Session. The new Session had scarcely opened, however, before the Government, having announced it in the King's Speech, re-introduced the Bill in the House of Commons. The extent of the opposition to the Bill is large and obvious; it is severely criticized by the Federation of British Industries, and unequivocably condemned by many electricity interests. It is not surprising, therefore, that more than 60 Members of Parliament, themselves mainly supporters of the Government, should petition that the Bill should be sent to a Select Committee for detailed consideration. This request, having regard to the magnitude of the issues involved and the technical nature of the measure, may appear to be reasonable enough, but the Government would have none of it. The Bill was forced through its Second Reading, which it passed by 113 to 27—out of a House of over 600, be it noted.

We of the Gas Industry have never desired to interfere in any legitimate re-organization of the internal and domestic affairs of our competitor, but we cannot forbear to compare the treatment which has been accorded to this Bill with the attitude of succeeding Governments to gas legislation. In season and out the Gas Industry called upon the Government of the day to give some relief from statutory obligations imposed upon the Industry in 1847. After much delay and indecision the question was submitted to a Committee; after the Committee had reported, the matter was placed before another Committee, and subsequently it was thought necessary for a third Committee to be appointed. When legislation came it omitted certain recommendations of the Committees to which the Industry attached very great importance, and the necessary Bill was only blessed by the Government in so far as it contained provisions which were thought to be non-controversial. In the Electricity Bill no one has been asked whether the measure is non-controversial, and the strongly urged plea that it should be considered by a Committee is ignored.

What is Behind It?

WHAT, then, one may ask, are the terms of this Bill? They are, in the first place, a deliberate breach of the understanding upon which the Electricity Supply Act, 1926, was based. It was of the essence of that Act that the Central Electricity Board should not itself distribute electricity, but should merely supply electricity in bulk to authorized undertakers at a specified tariff. The Bill now proposes that the Board be allowed to supply electricity to non-selected undertakers upon such terms as may be agreed between the Board and these undertakers; further, where " special circumstances " exist, that the Board may supply any undertakers at non-tariff rates if such undertakers will thereby be enabled to supply persons whose needs for electricity are of a " special nature." What, we may ask, are " special circumstances," and what needs are to be regarded as " of a special nature? " The Bill contains no answer to our inquiry.

No real need to ask such questions, perhaps, because the Minister of Transport has assured us that they will be determined by the Electricity Commissioners, " the impartial authority established by Parliament to determine this kind of question." (" Hansard," vol. 295, No. 8, page 1032.) But this is not sufficient. The Central Electricity Board are to have the power to sell electricity to Railway Companies for the purpose of " the haulage or traction of vehicles, and for the lighting of the vehicles for the haulage or traction of which electricity so supplied is used," and with the sanction of the Minister " partly for such purposes as aforesaid and partly for other purposes of the Company's undertaking,

being purposes for which the Company are entitled to use electricity." It will be open, therefore, for the Board to compete not only with the Gas Industry, but also with the electricity undertakers of the country for such a thing as " railway station lighting."

What, therefore, may we again ask, is behind this Bill? Is it, in the words of a prominent Member of the House, " that the Grid has failed on its merits and attempts to bribe private concerns, which are now prosperous, not to compete with them," or is it, in the words of another Member, an attempt " to bolster up the Electricity Board's finance? " It must be remembered that the Board has now borrowed £50 million, and that in 1936 it must begin to pay its interest charges out of revenue. The public have no real check on its accounts, which are not subject to the Comptroller and Auditor-General, and do not come before the Public Accounts Committee in the usual way. The natural desire of the public for further information on the whole subject of the Central Electricity Board's financial position has been increased one-hundredfold by the provisions of this Bill, and by the hasty insistence of the Government upon its rapid passage into law.

Unemployment Grants

Our readers will not require to be reminded of the importance of the case of *Barnes v. Birmingham Corporation* in regard to the effect of Unemployment Grants in relation to wear and tear allowances, or its indirect bearing on the ruling of the House of Lords in *Seaham Harbour Dock Company v. Crook*.

The *Seaham* decision was to the effect that, in the circumstances of the case, a Treasury Grant received by a public utility undertaking from the Unemployment Grants Committee was not a trading receipt liable to assessment to income-tax.

The decision of Mr. Justice Finlay when the *Birmingham* case came before the King's Bench Divisional Court was set out in the " Journal " for Sept. 13, 1933, and was welcomed as upholding the previous (Seaham) case. Briefly, the restriction imposed by sub-rule (6) of Rule 6 to Cases I. and II. of Schedule D of the Income-Tax Act, 1918—whereby the total allowances for wear and tear are limited to the " actual cost to that person of the machinery or plant—was held not to operate so as to withhold any allowance under this Rule on that part of the cost which may have been defrayed from an outside source.

It was not to be expected that the Revenue Authorities would surrender their contention—that the terms of this sub-rule did so limit the allowances granted under Rule 6—without an appeal to a superior Court; and in a later issue (" Journal " for Dec. 20, 1933) we reported the majority decision of the Court of Appeal. The Master of the Rolls dissented from the majority verdict of the Court, and, while not entirely accepting the views of the learned Judge in the Court below, Lord Hanworth agreed that the allowance granted by Rule 6 (1) of " such deduction . . . as representing the diminished value by reason of wear and tear during the year of any machinery or plant used for the purposes of the trade and belonging to the person by whom it is carried on," could not be restricted in the manner suggested by the Inland Revenue. On the latter's behalf the Attorney-General contended that the term " *actual cost* " *to that person* in sub-rule (6) was adopted by Parliament in contradistinction to " value " in Rule 6 (1) itself. The Master of the Rolls declined to accept this argument, and directed attention to the use of the word " actual " without very great precision in other Rules of the same Schedule. Lord Justices Slesser and Romer, however, were of the opinion that the Crown's contention must succeed—on the ground that sub-rule (6) was sufficiently definite to restrict the aggregate allowances to the net cost borne by the Corporation.

In our review of the case before the Court of Appeal we expressed the hope that the case would be taken to the House of Lords for a final decision on a legal point upon which such a diversity of opinion has been evidenced in the course of its progress from the Special Commissioners (who approved the ruling since given by the Court of Appeal). The Corporation of Birmingham have now entered an appeal to the House of Lords which will be heard during the present law sittings.

Without attempting to prejudge the case, we would venture to advise officials of undertakings which have received these Treasury Grants (or " adventitious sums ") to secure that, in the event of Mr. Justice Finlay's ruling being restored, it will be competent to invoke its aid in obtaining wear and tear allowance calculated on the full cost of the plant, notwithstanding the source of any part of the funds expended in the purchase thereof.

In view of the importance which attaches to this appeal we await the result with interest, more especially in view of a later decision of the King's Bench Division (in *Heyhoe v. Slough Theatre Company, Ltd.*, 1933) that where a taxpayer has incurred no actual expense in installing plant or machinery leased to him for the purpose of his trade, wear and tear allowance is not obtainable under Rule 6. Should it be that the present rulings of the Courts in the *Birmingham* and *Slough* cases are not disturbed, it is evident that the operation of Rule 6 dealing with the allowances for wear and tear in respect of machinery and plant will be appreciably curtailed to the detriment of many sections of industry.

The Tale of the Rates

We are once again indebted to Mr. W. Allison Davies, the Borough Treasurer of Preston, for his comparative statement of rates levied in various towns, together with certain other municipal statistics, including charges for gas and electricity supplies, and other matters. The places dealt with are divided up into County Boroughs, Boroughs, Urban Districts, and Metropolitan Boroughs. Dealing with the last-named first, we find that, of the 28 Metropolitan Boroughs, the rates for 1934-35 (except in the few cases where they are equal) are generally lower than those for 1933-34. Poplar is still at the top with a figure of 16s. in the pound, while Bermondsey comes next at 15s. 6d., compared with 15s. 8d. the previous year.

There are 84 County Boroughs included in the Return, the average rates of which, at 12s. 10d. in the pound, are almost 1d. lower than a year ago. The average rates for the 128 Boroughs named are 11s. 7¼d. in the pound—a fractional decrease on the figure of the year before. In the case of the 100 Urban Districts there has also been a small decrease in the average rates, which now stand at 12s. 7¼d. in the pound. Of these, Abertillery heads the list with a rate increased from 24s. to 27s. in the pound, while other rates in this neighbourhood not far short of the same figure—indeed, Merthyr Tydfil, a County Borough, exceeds it by 6d.—speak all too eloquently of the distressed industrial conditions which still prevail in the South Wales district. Of the Boroughs, Jarrow heads the list at 18s. 3d., an increase of 6d. on the previous year.

At the other end of the scale, we find that Westminster still has the lowest rates of the Metropolitan

Boroughs at 8s. 6d. in the pound, a decrease of 2d., while the most favoured places elsewhere are: Of the County Boroughs, Oxford, with a decrease of 2d. to 7s. 4d.; of the Boroughs, Hove, with a decrease of 4d. to 7s. 6d.; and of the Urban Districts, Esher, with a decrease of 3d. to 7s. 7d. in the pound. Of course, the figures of the total rates levied are not the same as the rates per head of population, which are low in some cases where the rates in the pound are high.

So far as particulars of domestic supplies are concerned, the Return gives the prices for gas per therm and per 1,000 c.ft. within and without the Borough or Urban District as the case may be, together with the declared calorific value of the gas supplied. Other figures of interest are the estimated transfers from municipal undertakings to the relief of the rates, and, conversely, the estimated transfers *to* municipal undertakings in respect of deficiencies. We are glad to be able to find but six examples of the latter throughout the whole Return, and the municipal gas undertakings which do fall into this category make a charge upon their respective rates of but £15,500 all told. On the other hand, there are 18 municipal gas undertakings which provide an aggregate sum estimated at roundly £134,700 towards the relief of the rates—the Nottingham Gas Department being the kindest in this respect with its estimated quota of £31,500. The large majority of municipal gas undertakings, however, are fortunately self-supporting, and able to direct their profits towards better service and a lower charge for gas.

Many other interesting comparisons could be made from the Return, which also gives details of the allocation of the rates in the various towns; but suffice it to repeat that a very profitable study may be made of Mr. Allison Davies' work, which, incidentally, is the fiftieth annual statement published.

On Principle

MANY are the wonders woven round the incandescent gas mantle, the history of which, since the taking out of the first patent by Auer von Welsbach something under half-a-century ago, reads almost like a fairy tale. It is one of the cases in which the inventor happily lived to witness the full success of his invention, which revolutionized gas lighting just at the time when it was most important that a revolution of some kind should be brought about, in view of the advent of electricity as a competitor.

As a lighting agent the incandescent mantle is not merely unsurpassed, but is unequalled, for the home, for the factory, and for the street. In matters of illumination it may be rightly introduced anywhere, but in matters of principle one does not expect it to be involved. Such a case has, however, occurred within the last few days, with results altogether incommensurate with the amount involved. That the benefits of good gas lighting should be dimmed, even temporarily, is greatly to be regretted; and that it should occur over a dispute about twopence, again reads almost like a fairy tale. Mantles nowadays are incomparably more robust than was the case when first they were invented, but even so there is a limit to the violence of the shock that they will successfully withstand, and this limit was exceeded by a man in a Lancashire mill when carrying a piece of cloth into the warehouse. A sum of fourpence was demanded of him for a new mantle, but rather than pay this he worked without a light over his looms. It must be that the principle was highly important, for otherwise no one would deprive himself of the comfort and convenience of an incandescent gas light for the sake of saving fourpence. Trifling, too, as is this sum, it was halved on the intervention of the weavers' union, who took up the matter, and came to an agreement with the employers whereby "each side was to pay half the cost of the mantle." In addition, we learn from a correspondent of *The Times*, "it was agreed to go into the matter further, and after negotiations the weaver again made a report to the union." Thereupon the firm were told that if they did not put in a new mantle work would cease. They refused, and the correspondent states that more than 300 weavers were called out on strike.

We are not told whether, when leaving the mill, the men trampled under foot the pathetic little fragments of rare earths which, in the form of a gas mantle, had been dedicated to their great benefit, but even without such signal ingratitude as this we are sorry that what should always be a blessing has on the present occasion brought misfortune in its train. The mantle will not, however, have lost its life in vain if the real lesson be learned. Co-operation, co-operation again, and yet more co-operation.

Forthcoming Engagements

December.

6.—MIDLAND JUNIOR ASSOCIATION.—Meeting and Paper by Mr. S. Brockbank (Walsall).

8.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Meeting. Paper by Mr. J. Bateman.

11.—N.G.C.—Meeting of Central Executive Board, 28, Grosvenor Gardens, S.W. 1, 11 a.m.

13.—NATIONAL GAS COUNCIL.—Meeting of the Central Executive Board, at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m.

13.—S.B.G.I.—Council Meeting, 2.30 p.m.

14.—SOUTHERN ASSOCIATION.—Western District Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.

14.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and Paper by Mr. G. P. Manning.

15.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION. Meeting at Cardiff. Paper by Mr. G. S. Leonard.

15.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting in Sheffield. Presidential Address of Mr. R. Halkett, Jun.

19.—B.C.G.A.—Meeting of Executive Committee, 28, Grosvenor Gardens, 11 a.m.

January.

3.—MIDLAND JUNIOR ASSOCIATION.—Meeting at Nottingham and paper by Mr. W. L. Howe.

12.—WESTERN JUNIOR ASSOCIATION.—Visit to Yeovil and paper.

12.—SCOTTISH JUNIOR GAS ASSOCIATION.—Joint Meeting at Glasgow. Paper by Mr. Stephen Lacey, of London.

19.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION.—Meeting at Porthcawl. Paper by Mr. G. Thomas.

19.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Sheffield. Paper by Dr. Fritz Gummert (Director of the Ruhr Gas Company).

23.—B.C.G.A.—Manchester District Meeting, Manchester.

24.—B.C.G.A.—Yorkshire District Meeting, Leeds.

25.—B.C.G.A.—Northern District Meeting, Newcastle-on-Tyne.

25.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and paper by Mr. S. F. Dunkley.

31.—B.C.G.A.—South-Western District Meeting, Exeter.

February

7.—B.C.G.A.—Eastern District Meeting, Cambridge.

14.—B.C.G.A.—Midland District Meeting, Birmingham.

Correspondence

Mr. Kirkwood's N. of E. Paper

SIR,—On reading through the report of the discussion on my Paper given before the Auxiliary Section of the North of England Gas Managers' Association on Nov. 24—"JOURNAL" for Nov. 28—I find that part of it may lead to a certain amount of misunderstanding.

In the report it states "Mr. F. Nicholls (Gateshead), referring to the figure of 16% for the carbon dioxide of the flue gases . . . &c." This figure of "16" was actually referred to as the weight in lbs. of coke used in the producers per 100 lbs. of coal carbonized, and not as a percentage of carbon dioxide.

Yours, &c.
W. OLIVER KIRKWOOD.

Sunderland Gas Company,
Hendon Gas-Works,
Sunderland,
Nov. 30, 1934.

Concentrated Gas Liquor

SIR,—The observations made by me on the Fourth Report of the Liquor Effluents and Ammonia Sub-Committee ("JOURNAL," Nov. 14, p. 320) were specific, and do not admit of misunderstanding.

Definitions of concentrated gas liquor and concentrated ammonia liquor have existed for more than thirty years, and such definitions were reaffirmed during the war.

One can scarcely concede new definitions, such as "crude concentrated gas liquor" or "semi-pure aqueous solutions concentrated to 25% ammonia," because these terms can only lead to confusion.

The fact remains that concentrated gas liquor, as known for thirty years, has a specific gravity greater than 1·0, and concentrated ammonia liquor, as known for a similar period, has a specific gravity less than 1·0.

My remarks, therefore, about the transport costs of the two products, on the occasion referred to, were correct. Indeed, such remarks are less likely to cause misunderstanding than the new definitions which Mr. Wilton seeks to introduce.

For obvious reasons, the related matters about which Mr. Wilton speaks in the last three paragraphs of his letter are not such as can be dealt with by correspondence, but the Chairman of the Liquor Effluents and Ammonia Sub-Committee knows that there was justification for what I said.

Generally speaking, where concentrated gas liquor is treated *exclusively* by chemical works in the manufacture of special fertilizing products, a price of 1s. 3d. per unit of ammonia, under the conditions named, can be paid.

Yours, &c.,
P. PARRISH.

57, *Westcombe Park Road,*
Blackheath, S.E. 3,
Dec. 1, 1934.

"Propaganda and Propaganda"

SIR,—You refer in a leading article this week to the inaccuracy of electrical propaganda in a recent Housing Supplement of the *Daily Telegraph*. How, I wonder, do our electrical friends explain the claim made by them in that Supplement that "throughout three-quarters of the country electricity is available at about ½d. a unit. This makes it cheapest and most convenient for heating, cooking, water heating . . ."

I should very much like to see an explanation from E.D.A. as to how they reached this interesting conclusion. Even if they had forgotten the standing charge (which I am sure they had not, for it would be a most dishonest omission) I should still be curious to hear them defending their assertion.

No doubt, Sir William Ray is as anxious as anyone to keep his advertising truthful, so I look forward to reading what he has to say in reply to this letter in your next issue.

Yours faithfully,
MR. THERM.

Nov. 30, 1934.

Personal

It is announced that, in consequence of his appointment as Prime Minister of Belgium, Monsieur GEORGES THEUNIS, G.C.M.G., has resigned his seat on the Board of the Imperial Continental Gas Association.

* * *

Mr. R. J. REW, of Messrs. Willey & Co., Ltd., gas meter makers and engineers, of Exeter, and Managing Director of the Devon Gas Association, was, on Nov. 27, appointed to represent the Exeter and District Incorporated Chamber of Commerce on the Juvenile Employment Sub-Committee of the Exeter City Education Committee.

* * *

Alderman J. E. COX, J.P., and Councillor W. T. POULTNEY, J.P., have been appointed Chairman and Vice-Chairman respectively of the West Bromwich Gas Committee. It is interesting to note that Alderman Cox was elected an Alderman, Mayor of the Borough, and Chairman of the Gas Committee in the year 1919, and has been Chairman ever since.

Obituary

The death occurred suddenly on Nov. 25 of Mrs. LILY EDITH WHITE, the wife of Mr. F. C. WHITE, M.Inst.Gas E., Manager of the Blaenavon Gas Company.

* * *

We regret to announce the death of Mr. JAMES HATTON, who was for many years a Director and Representative of John Ruscoe & Co., Ltd., Gas, Water, and Mechanical Engineers, Albion Works, Hyde, Manchester. He was widely known to Gas Undertakings all over the country.

* * *

The funeral took place at Haslingden on Nov. 28 of Mr. WILLIAM H. PRESTON, of Fleetwood Road, Bispham, who was a Director of the Fleetwood Gas Company. He was aged 83.

Walker Technical College.

Helping Industrial Shropshire.

Much progressive work in technical education in the industrial part of Shropshire is being carried on at the Walker Technical College, Hartshill.

This was emphasized at the annual distribution of awards last week in a speech by Mr. C. C. Hawkins, M.A., M.I.E.E. (City and Guilds of London Institute).

Mr. R. J. Milbourne, J.P. (the first Chairman of Governors), who presided, said that in this pleasure-seeking age the desire for everything that could make life easy and entertaining had a strong tendency to ignore the necessity of further educational studies after leaving school, and to push other considerations into the background.

In that district, however, many young people realized that it was essential to have technical knowledge as well as practical experience to qualify for the best positions in industry.

It would be helpful if employers made themselves more conversant with the difficulties that often had to be faced by students, and found out from time to time whether students were benefiting as they should, and devoting both time and energy to their work in the classroom and private study.

There had been some outstanding successes—one student gained the City and Guilds of London Institute Silver Medal in the advanced stage of Company Law, and Mr. Eric B. Smith had been awarded the All-England Bronze Medal for Gas Fitting and First-class Certificate (Grade 2) of the City and Guilds of London Institute.

Mr. Eric Smith is 20 years of age, and he is serving his apprenticeship with the Wellington (Salop) Gas Company.

After presenting the awards, Mr. C. C. Hawkins gave an address on the London City Livery Companies and their origin.

In a note last week referring to the death of Mr. John Taylor, late of Coleraine, we unfortunately gave incorrect initials to Mr. S. B. Langlands, for which we apologize. Mr. Langlands is, of course, in charge of the public lighting of the City of Glasgow of whatever kind, his position being quite distinct from either the Gas or the Electricity Department.

News In Brief

A Gasholder for Sale.—Middlesbrough Corporation is offering for sale a gasholder of two and a half million cubic feet capacity.

An Increase was reported by the Lancaster Corporation Gas Engineer of 1·5% in the amount of gas distributed during October as compared with the same month of last year.

Extension of Limits within which the Derby Gas Light and Coke Company are authorized to supply gas is among the powers they are seeking in a Special Order under the Gas Undertakings Acts, 1920 to 1934.

Annan Floodlighting.—In connection with the Edward Irving Centenary Celebrations being held this week in Annan, the old Parish Church and the Edward Irving Monument are to be floodlighted by Annan Gas Company.

The Position of Engineer and Manager to the County Borough of Rochdale Gas Department is vacant, and the Town Clerk invites applications for the post, which carries a commencing salary of £800, from applicants who are over 46 years of age.

During the Reconstruction of their premises in High Street, Hythe, the Folkestone Gas and Coke Company have borrowed the travelling showroom of the Hastings and St. Leonards Gas Company in order to carry on their business without interruption.

The Gas Lighting Installations in the streets of Whitley Bay were recently inspected by representatives of the municipal gas undertakings in the North-East Coast Area. The party were very impressed by the brilliance and even distribution of the lighting.

Industrial Co-partnership Association.—Mr. B. Seebohm Rowntree, C.H., will take the Chair at the next Monthly Lunch at the Holborn Restaurant on Thursday, Dec. 6, when Sir Arthur Salter, K.C.B., will speak on "National and World Recovery."

Orders for Coke Grates amounting to over 800 were reported by Mr. S. Parry, Commercial Manager to the Oldham Gas Department, at a recent meeting of his Committee. He thought it was very satisfactory that people were inquiring about them without being approached.

Application is being Made to the Board of Trade by the Mossley and Saddleworth Gas Company, Ltd., for a Special Order enabling them to purchase the Mossley Corporation Gas-Works and to acquire the rights, powers, and privileges of the Corporation in respect of the Undertaking.

Johnstone Gasholder Contract.—Johnstone Corporation Gas Committee, after considering the corrected tenders for the new gasholder to be erected, has accepted that of Messrs. R. & J. Dempster at a figure of £6,841. The Manager reported that the work on the new holder will not commence until March.

Thirty Collin Regenerative Coke Ovens are to be erected by Messrs. Gas Chambers and Coke Ovens, Ltd., of Artillery House, Westminster, S.W. 1, for the Lambton Hetton and Joicey Collieries, Ltd., Fence Houses, Co. Durham. This contract is additional to that for ten similar ovens recently announced in these columns.

Cookery Demonstrations were recently held by the Chesterfield Gas Department at their showrooms in Knifesmith Gate. The Chairman of the Gas Committee (Alderman G. Clarke), at the opening by the Mayoress, made mention of the fact that during the past twelve months there had been an increase of 12% in the output of gas.

A Saving of £56,000 on their gas bills during the past year as compared with the year 1930-31 was accorded by the Dundee Corporation Gas Department to their consumers on account of reductions in the price of gas. This gratifying fact was made known when Mr. R. Loggie, Convener, of the Gas Committee, commented upon the Annual Report presented by Mr. John Wilson, their Engineer and Manager. During the past four years a sum of £150,000 had been saved to consumers.

A Broadcast Concert was given on Friday evening, Nov. 30, by the Newbridge (Bath) Male Voice Choir (comprising Employees of The Horstmann Gear Company, Ltd.) from the new B.B.C. studio at Bristol in the West Regional Programme. This is the second Broadcast Concert the Choir have given this year, the previous one being in February. The Choir was formed eight years ago and is well known in the Bath District, having given concerts at the Pump Room and Guildhall and for various charitable organizations.

Readers of the "Evening Standard" may possibly not have connected the Mr. N. A. Birks, whose vivid account of his attempted escape from Germany was told in a recent issue in the report of the Officers Prisoners of War Dining Club Annual Dinner, with the well-known gas engineering firm of Abbott, Birks, & Co. Actually, Mr. Norman Birks is a Partner of the firm.

A Special Order under the Gas Undertakings Acts, 1920 to 1934, is being sought by the Rhyl Urban District Gas Department. Among the purposes of this Order is to enable the Council to purchase the Abergele Gas, Coke, and Water Company, Ltd., to extend their area of supply, and to make provision as to the price or prices to be charged for gas in the extended limits.

Among the Powers sought by the Newcastle-under-Lyme Gas Department in a Special Order application under the Gas Undertakings Acts, 1920 and 1929, are: The extension of their area of supply, the repeal of the powers of the Kidsgrove Gaslight Company with reference to the supply of gas in that area, and the purchase of land for the manufacture and storage of gas.

A Price Reduction is proposed by the Birkenhead Corporation Gas Committee of 2d. per 1,000 c.ft. The new scale of charge is as follows: Ordinary lighting (subject to the scale of discount, one million to five million c.ft. per annum, 2½%; over five million c.ft., 5%) from 3s. to 2s. 10d. per 1,000 c.ft., or 8d. to 7½d. per therm; prepayment consumers, from 3s. 9½d. to 3s. 7½d. per 1,000 c.ft., or 10·1d. to 9·6d. per therm.

A Series of Demonstrations was held during the past week by the Rugby Gas Company. The showrooms were laid out with a comprehensive selection of cookers, washers, fires, and other appliances of all makes, attractively decorated, with a Christmas tree as a centre piece. Cookery demonstrations were given twice daily by Miss R. M. Thring, N.C.D.S., who made a special feature of Christmas Fare. There was a daily average attendance of about a hundred.

A Ministry of Health Inquiry was held at Bethesda into the Council's application for sanction to float a loan of £2,373 for the provision of a new plant and gasholder. Mr. Roger Evans stated that the Gas-Works were built in 1885 and for some years were let on lease to a private company. Since the Council took it over they had spent over £1,600 on repairs and new plant. The estimated revenue from the undertaking was £2,100, on which last year a profit of £93 was made. The number of consumers is 574.

The Question of Meter Rents was recently considered by the Lockerbie Town Council Gas Committee, and it was agreed, in view of the high cost of the upkeep of slot meters, to recommend to the Council that the charge for each of the survey periods—namely, May-November, November-February, February-May, should be as follows: (1) In cases where the consumption of gas for the survey period is less than 5,000 c.ft., an addition of 5d. per 1,000 c.ft. be made to the price being charged. (2) In cases where the consumption of gas for the survey period is 5,000 c.ft. or more, there be a fixed charge of 2s. The recommendation was adopted.

When Business Was at its Height in Shrewsbury the other evening the town's shopping centre was plunged into darkness by a failure of the municipal electricity supply. Many shops had to close; others carried on in the dim light of candles, and only a few wise tradesmen were able to boast an alternative gas supply. The post office was in darkness, general market business was at a standstill, and automatic signals were out of commission. The only premises brilliantly illuminated were the offices of the local gas company, whose windows were displaying life-size photographs of the Duke of Kent and Princess Marina, and attracted big crowds. The breakdown lasted over half an hour.

An Exhibition of domestic appliances was held recently by the Birstall Urban District Council in the James' Hall of the Constitutional Club. The display of coloured gas fires aroused much admiration. Cookery demonstrations were given during the week by Miss E. K. Eason. Mr. J. Wallis, Chairman of the Gas Committee, presiding at the opening of the exhibition, spoke of the many functions of gas in the modern home and also of the development of compressed gas for heavy transport, a matter in respect of which the Birstall Council were very interested. Six months ago the Council had reduced the price of their gas by 4d. per 1,000 c.ft., after a reduction of 10d. last year, and had abolished meter rents.

Sir Arthur Duckham Memorial Fund.

Official List of Donations between Sept. 29 and Nov. 30.

Name and Town.	Amount. £ s. d.
W. H. Johns, Swansea	1 0 0
Municipal Engineering	2 2 0
Donations (2) paid above	3 2 0
Donations (630) paid previously	10,630 18 8
Total Donations (632) paid	£10,634 0 8

A Gas Company Changes its Name.

We have been informed by the District Gas Company (Heathfield), Ltd., that, "in accordance with a Special Resolution passed by the Company and a Certificate issued by the Registrar of Companies dated the 22nd November, 1934, the name of the Company is altered to the 'Heathfield Gas Company, Limited.'"

Wales and Monmouthshire Junior Gas Association.

On Tuesday, Nov. 27, members of the Association paid an Official Visit to the Engineering Exhibition which was held at the Greyfriars Hall, Cardiff, under the auspices of the South Wales Institute of Engineers. The Association were officially received by Mr. J. Macleod Carey, President of the Institute. Mr. A. D. Howells, President, replied to Mr. Macleod Carey's address of welcome on behalf of the visitors. After a tour of the Exhibits the members were entertained at tea. Among others present were Mr. H. S. Bartlett, Cardiff, Mr. S. E. Brett, Rhondda, Mr. C. B. Felton, Newport, Mr. F. S. Johns, Swansea, and Mr. A. W. Stickler, Cardiff.

Aberdeen Extensions.

The Aberdeen Gas Committee have recommended that the gas mains be extended in various new streets throughout the town at an estimated cost to be £840.

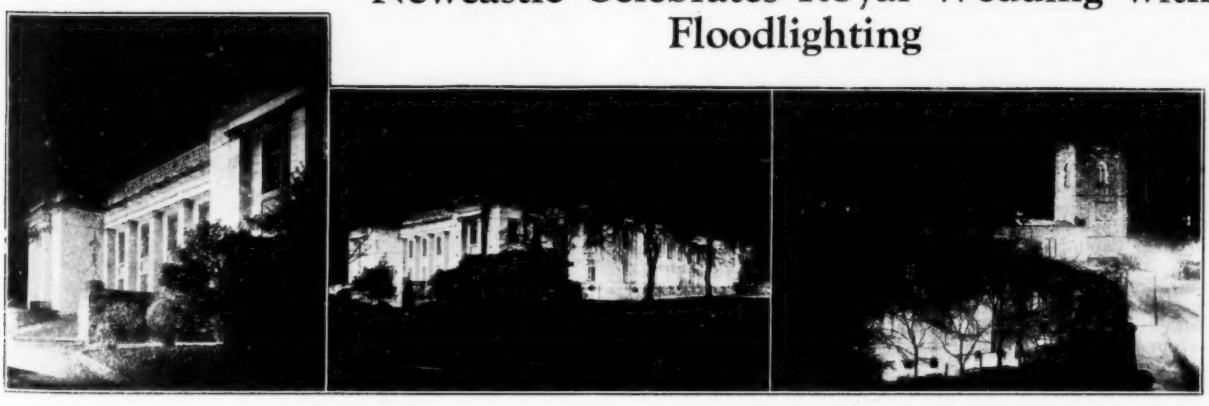
In order to give a better supply of gas during peak hours in the northern district of the Aberdeen gas area at Stoneywood and Dyce it was recommended that a booster should be installed at the Gas Department's premises at Scatterburn for the sum of £175, which includes work to be carried out by the Department.

In a statement of the output of the Gas Department for last month compared with the same month last year, it was shown that 2,024,000 c.ft. more gas had been made, 265 tons more coke had been sold, and that the revenue from coke had increased by £223 7s. 9d. The tar products and ammoniacal liquor, however, realized £440 less.

Gas Exhibition at Okehampton.

An exhibition of gas appliances and cookery demonstrations were held by the Okehampton Gas Company, Ltd., at Okehampton last week. The demonstrations were given by Miss D. M. Gillham, of R. & A. Main, Ltd., and appliances were supplied by R. & A. Main, Ltd., the Parkinson Stove Company, Ltd., and Economic Gas Boilers, Ltd., who also arranged washing demonstrations. Considerable local interest was aroused, and the exhibition was well attended. The normal electric lighting of the hall was dispensed with and gas lighting substituted, the improvement calling forth much favourable comment. The outside of the hall was floodlighted by two 12-light lamps by Foster & Pullen, Ltd. The whole of the arrangements were carried out by the staff of the Okehampton Gas Company, under the direction of the Engineer and Manager, Mr. J. C. Cotterill.

Newcastle Celebrates Royal Wedding with Floodlighting



The Hancock Museum. St. John's Church.

For the first time in 800 years the proud old Church of St. John in Grainger Street West, Newcastle, has been seen in a new setting. The exterior of the Church was floodlighted by gas by its next-door neighbours, the Newcastle and Gateshead Gas Company. The Hancock Museum in Barras Bridge was also similarly illuminated. The Vicar and Churchwardens of St. John's Church and the Council of the Hancock Museum readily granted permission for the floodlighting by gas of the exterior of these buildings for the occasion of the Royal Wedding. For the floodlighting of St. John's Church some 43 high-power gas lamps of a candle power amounting to 135,000 were utilized. The floodlighting showed up to the best advantage the architectural beauties of the old stonework against the background of dark sky. The lighting was deliberately varied, special features and contrasts being emphasized, this being much more effective to the eye than even illumination. For the floodlighting of the Museum, 34 powerful gas lighting units of a candle power amounting to approximately 153,000 were used. The gas lamps used were by Messrs. Foster & Pullen, Ltd., of Bradford. The Authorities granted free admission to the Museum; thousands of people visited the Museum and inspected the old Church of St. John—the gas floodlighting of these two buildings thus receiving considerable publicity.

Topical Window Displays at Margate.

Our photograph shows the window display, in one of the showrooms of the Isle of Thanet Gas Light and Coke Company, in connection with the Royal Wedding. A similar display appears in each of the Company's three showrooms. The general scheme is silver and blue, the archway being constructed of beaver boarding and painted to represent an old arch, with ivy running round it. The internal portion of the arch is pleated with light blue, and a red carpet runs up to the gateway, with a pot of chrysanthemums and a palm on each side, while the wings are pleated in royal blue with scalloped frieze. The display is very attractive, and is creating a considerable amount of public interest.

A Solvent for the Gas Industry.

Tetrahydronaphthalene for Clearing Distribution Systems.

Imperial Chemical Industries, Ltd., are shortly to put in operation a new process for the manufacture of tetrahydronaphthalene which is to be marketed under the name of "Tetranap." The significance of this development lies in the fact that plentiful supplies of an exceptionally pure grade of the solvent are to be made available in this country at a low price.

Better known as "Tetralin" (its registered trade name as manufactured in Germany and America), tetrahydronaphthalene is a water-white liquid of great stability, manufactured by the catalytic hydrogenation of pure naphthalene. Its use either in liquid form in scrubbers or in the form of vapour introduced into the actual gas stream has for some time been well-established practice in Germany and America for the prevention and removal of naphthalene and gummy deposits in gas distribution systems. In both these countries the method is stated to have been developed with considerable success.

The close chemical relationship of tetrahydronaphthalene to naphthalene makes it the most powerful solvent for that substance known to industry, and its volatility being low, comparatively small amounts are sufficient to saturate the gas. Simultaneously with their announcement, I.C.I. have published a booklet dealing concisely with the causes and effects of naphthalene chokes and gum deposits, and the methods by which "Tetranap" may be used to effect their prevention and removal. The properties of "Tetranap" are fully described, as well as all its possible applications in the Gas Industry, either as a liquid-scrubbing medium, or in two alternative processes of "fogging" directly into the distribution system. The tables given, showing solubilities and the vapour tensions of "Tetranap" and naphthalene at various temperatures, indicate that, for a given fall in temperature, sufficient "Tetranap" vapour is condensed to dissolve all the naphthalene and gums present at any time, the fine persistent fog which it forms condensing in the mains at the same time as naphthalene, and in amounts more than sufficient to dissolve it.

It is pointed out how "Tetranap" is of use in corrosion and dust difficulties, owing to its tendency to condense in a thin protective layer on the internal surface of the mains. "Tetranap" is also claimed to have a beneficial action on the leather diaphragms of meters.

As a scrubbing medium, it is claimed that the high boiling point and narrow boiling range greatly simplify debenzolization. Owing to the high temperature coefficient for the solubility of naphthalene in "Tetranap," the naphthalene may be almost completely removed by cooling the solution a few degrees.

Firing Enamelled Metal Ware.

The use of electric furnaces for firing enamelled metal ware was declared to be uneconomical by Mr. E. Geisinger, B.Sc., of Enamelled Metal Products Corporation, when addressing a joint meeting of the Glasgow Sections of the Society of Chemical Industry and the Institute of Chemistry in the Royal Technical College, Glasgow, on Nov. 30.

Mr. Geisinger delivered a paper on "Recent Developments in Silicate Enamels and a Study of their Industrial Uses," and in the course of his lecture described various types of furnaces used for firing enamelled metal ware. Electric furnaces, he said, had been used for this purpose, some people considering that to be modern one had to use electricity. This so-called modernization he thought could be carried too far, and the use of electric furnaces for firing enamelled metal ware was, in his opinion, uneconomical. Since in enamelling cleanliness is essential, the use of gaseous or oil fuel is preferable to raw coal or coke.

Gas Cookers in "Marina" Green.

The enterprise of the Parkinson Stove Co., Ltd., is again witnessed by the exhibition in their showroom window at Terminal House, Grosvenor Gardens, and display cases at Paddington and Euston Stations, of their "Calthorpe" cooker finished in the new "Marina" green, so soon after the approval of this colour by the British Colour Council. The artistic feature pieces designed to display these attractive gas cookers created considerable public interest, being of such a topical nature. Some idea of the topicality of these displays will be appreciated by the fact that the Paddington Station Showcase is situated on No. 1 platform where the Duke and Duchess of Kent entrained for Birmingham after the Wedding. The Parkinson Stove Company are producing and popularizing this new colour in vitreous enamel on their "Calthorpe" cookers.

Gas Cooking Equipment in Overseas Restaurant

The accompanying photographs illustrate a large-scale gas cooking installation by John Wright & Co., Ltd., of Birmingham, which is in daily use in an important overseas restaurant. So complete a lay-out of special gas cooking apparatus will appeal to gas engineers as an excellent example of a fully equipped gas kitchen.

The "Rivercourt" Lamp.

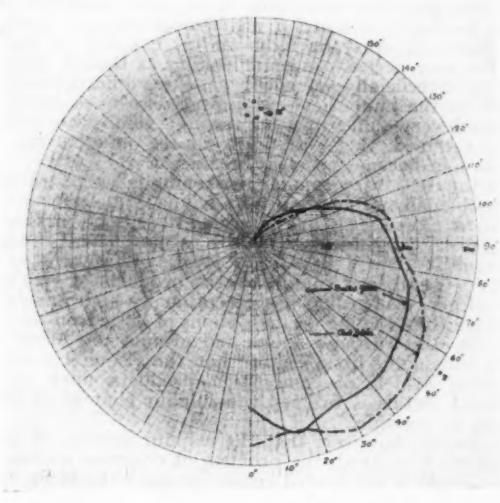
An exceptionally high illuminating efficiency is claimed for this lamp by the manufacturers, Messrs. W. Edgar & Son, Ltd., Blenheim Works, Hammersmith, W. 6. The casing, globe-carrying ring, and top cover are made of stout gauge copper. The bushes for the regulating screws are arranged to be as nearly as possible flush with the casing, thus preserving a practically unbroken contour. The whole of the exterior is chromium-plated. The burner is of brass throughout with the exception of the superheater box, which is of cast iron, and carries five or six long "Bijou" mantles, each having a gas consumption of 2 c.ft. of gas per hour.

Showing the Neat Appearance of the Unit.

Both gas and air regulation are effected from the exterior of lamp with a screwdriver. The gas regulation both of the burner and the by-pass is worked by means of fine threaded screws with stout phosphor-bronze springs under the heads to keep them in position when the correct adjustments have been made.

The housing for the main gas-regulating screw, which also carries the injector, can be withdrawn from outside the lamp for cleaning or renewing injector without disturbing any other portion of the burner.

The whole of the burner and the by-pass body are mounted on a cast brass supporting ring, on the underside of which is fitted the white enamelled steel bowl-shaped reflector. This reflector can be removed in a moment by loosening two wing nuts, allowing all the interior fittings to be easily accessible for inspection or cleaning.



This Diagram gives the Polar Curves—the Full Line being of Lamp with Clear Globe and the Dotted Line with Obscured.

The globe carrying ring is fitted with a heavy cast brass hinge and specially designed fastening which, when in the closed position, is securely locked.

The lamp is designed for outside shop and street lighting, and is supplied with clear or obscured globe. Should it be required for directional lighting a special "Holophane" globe can be supplied.

AUTUMN RESEARCH MEETING OF THE INSTITUTION

Nov. 6 & 7, 1934.

Written Contributions and Replies to the Discussions

Communication No. 100—Corrosion from Products of Combustion of Gas, Part II.; Tube Experiments (34th Report of the Joint Research Committee of the Institution of Gas Engineers and Leeds University).

Dr. U. R. EVANS (Cambridge University) wrote: I have read the 34th Report of the Joint Research Committee with great interest, all the more because a year ago, during a visit to Professor Cobb at Leeds University, I had the privilege of seeing some of the work in progress. I feel that the results are of real value, and that the general conclusions may be accepted as correct. It is, of course, always possible to find points where the damage to metals as assessed in laboratory experiments will not exactly indicate the damage liable to occur in service, and, in calling attention to one of these points, I have no intention to criticize the work, which appears to me admirable.

The damage to the metal is in this research mainly assessed by the weight of metal corroded; this is the usual criterion, and one which—I confess—I have generally used myself. But some of the most dangerous cases of corrosion known have been those where the amount of material which has suffered alteration was comparatively small, but where the attack has either dug down locally as small pits, leading to premature perforation, or alternatively has penetrated along the edges of the crystal-grains, causing serious loss of strength to the metal. Two French chemists, Chaudron and Herzog,* have recently introduced an "index number" for representing the degree of localization of corrosion; this is obtained by dividing the percentage loss of strength by the percentage loss of weight. Where corrosion is absolutely uniform, removing or altering a layer of equal thickness over the whole surface, this index must be 1·0; but where there is local attack, pitting or intergranular penetration, it is known to rise as high as 8·6 (and probably much higher). Pitting, even in its less conspicuous forms, is usually capable of detection by examining the suitably cleaned specimens under a good (preferably binocular) microscope; I have no doubt that Mr. Wood and his colleagues have this possibility in mind. But intergranular weakening is on some materials impossible to detect except by mechanical tests; I have seen specimens of different light alloys, exposed to the open air for long periods, and all looking as though they were merely superficially corroded; yet these different materials, which to the human eye all appeared to have fared alike, behaved very differently on testing; some were found to have retained their strength almost unimpaired, while others had become seriously weakened.

Fortunately intergranular weakening is less characteristic of acid condensates than of alkaline atmospheres. The classical example is the so-called "season-cracking" of imperfectly annealed brass by atmospheres containing ammonia.† Yet I have seen a case of fracture to brass under a small load caused by the products of combustion of coal gas, evidently a gas exceptionally high in sulphur—to judge from the big accumulations of basic iron sulphates, &c., on steel surfaces above and around the burners. I have personally little doubt that the rational method of reducing attack of combustion products upon the less resistant metals is to keep the sulphur content of the gas as low as possible.

Assuming, however, that the sulphur content of the gas is regarded as fixed, the problem of ensuring immunity to metal-work in gas-heated rooms becomes the same as that of ensuring immunity to human health. Although the constituents harmful to metals (sulphur oxides, &c.) are not those harmful to men (carbon monoxide, &c), yet flues adapted to removing thoroughly the one group will remove the other. On this matter, I can claim no specialist knowledge, but I have often wondered whether the shape of hood provided above the ordinary gas fire or gas oven is suited to capture anything like 100 per cent. of the products of combustion; the fact that metal ornaments, and especially silver, appear to become dull more rapidly in gas-heated rooms than others seems to confirm my belief that it is not. Mr. G. F. C. Gordon, of the Engineering Department of Cambridge University, with whom I have had the advantage of discussing these matters recently, attaches special importance to the problem of the "wind-proof flue," pointing out that it would be greatly in the interests of the Gas Industry that a satisfactory design, which would prevent all back-draught even under the most adverse wind conditions, should be adopted in standard practice. Another matter—only too well known to gas engineers—is the danger of blockage of the flue, a blockage which may give no warning—unlike the obstruction of a coal fire chimney, which fills the room with smoke. Doubtless cases where life or health have been endangered by the poisonous products of combustion are rare; but there is little doubt that the fear of such things does limit considerably the extended use of this convenient method of heating. Seeing that the distribution of pressure in a chimney that is drawing properly must be very different from that in a blocked chimney, it should not be beyond the wit of man to devise a differential pressure gauge and relay which would ring a bell or light a neon lamp when the flue ceased to function properly. I speak as a layman—probably an exceptionally ignorant layman—on this matter. For all I know, the Institution of Gas Engineers may have devised such an instrument; but, if so, I can assure them that there is at least one member of the gas-burning public who is uninformed of its existence, and that is myself.

Dr. W. H. J. VERNON (Chemical Research Laboratory, Teddington) wrote: This Written Contribution refers to the diagram shown at the 6th Autumn Research Meeting by means of slides, which, by the courtesy of the Faraday Society, are now reproduced as Figures A, B, C, and D. Figure A* illustrates, what I believe is important to bear in mind in problems such as the one now under discussion, that quite serious corrosion may occur under humidity conditions well removed from the meteorological dew point. It illustrates also the phenomenon of "critical humidity." During period W (mean relative humidity 43 per cent.), although the iron specimens (Curve B) were rusting, rate of attack was falling off and the total attack was not serious. As soon as the critical humidity was passed, however, on emerging into Period S (mean relative humidity 78 per cent.) there was an enormous increase in the rate, and at a little later stage rust fell freely from the specimens. Another point, which may be of interest to gas engineers, is that corrosion is not due entirely to gaseous pollution. This is shown by Curve A, which represents the behaviour of adjacent specimens screened from suspended solid particles inside a muslin "cage." The very small amount of action was confined entirely to the edges of the specimens, the polished surfaces of which remained perfectly bright, in striking contrast with the heavily rusted condition of specimens outside the cage. Moreover, on subsequent exposure to unscreened conditions, pre-exposed specimens remained practically unaltered for some time, while freshly-cleaned specimens rusted appreciably, thus demonstrating the development of an invisible protective film of oxide during the period of pre-exposure.

Similar invisible films were produced on lead† without recourse to screening, and pre-exposed specimens were found to have remarkable resistance to tarnishing as compared with freshly-cleaned specimens. This bears out the remarks of a speaker in the discussion (Mr. W. Singleton) who, referring also to lead, urged the importance of taking into account the freedom or otherwise of the specimen from surface oxidation. In contrast with these results for purely atmospheric conditions of attack, however, Bengough and

* E. Herzog and G. Chaudron, 8me Congres de chimie industrielle (Chim. et Ind., 1929, Special Number (Feb.), p. 335).

† H. Moore, S. Beckinvale, and C. E. Mallinson, J.Inst.Met., 1920, **23**, 225; 1921, **25**, 35; 1922, **27**, 149; 1923, **29**, 285.

* Trans. Faraday Soc., 1927, **23**, 160.

† *Ibid.*, 158.

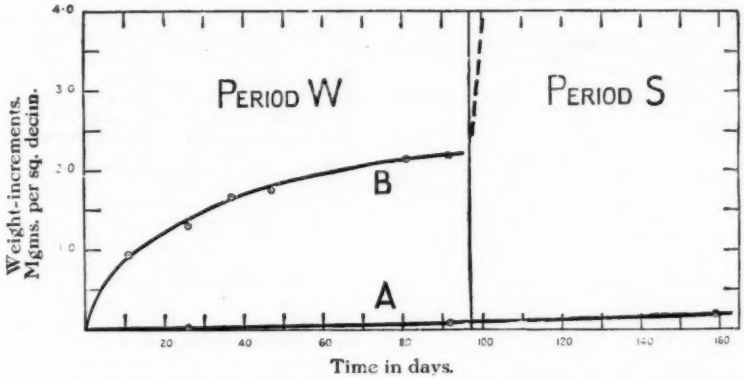


FIGURE A.—*Rusting of Iron in Room Atmosphere containing the usual Suspended Solid Particles (Curve B). Immunity of Iron screened behind Muslin (Curve A). Mean Relative Humidity—Period W, 43 per cent.; Period S, 78 per cent. (The Vertical Ordinate of Curve B at 159 days has a Value of 48·5 mg/dm², equivalent to more than 12 times the total height of the Diagram.)*

his collaborators have shown that under entirely "immersed" conditions in many salt solutions, the presence of invisible oxide films on the surface of iron and mild steel affects corrosion distribution only in the very early stages; the ultimate effect is negligible.

Figure B bears rather more directly on the work of the present report. It represents the behaviour of copper in a synthetic atmosphere containing a high proportion of

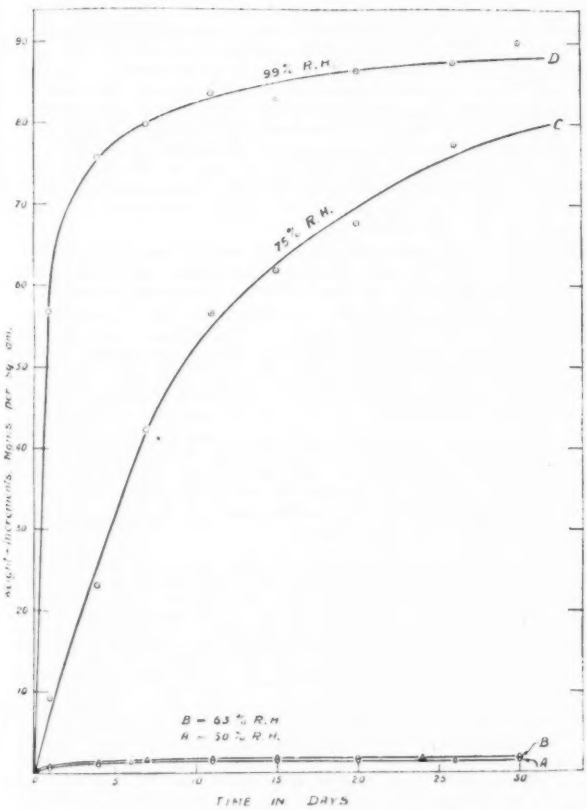


FIGURE B.—*Corrosion of Copper in Synthetic Atmosphere containing 10 per cent. Sulphur Dioxide. Influence of Relative Humidity.*

sulphur dioxide, at a temperature of 25° C. The curves bring out a point mentioned in the report as to the high initial rate of attack, which rapidly "flattens out;" a similar behaviour is realized at far lower concentrations of sulphur dioxide, and is always most marked at the highest relative humidities. "Critical humidity" is here well brought out, as witness the negligibly small attack, with practical identity of curves, for 50 and 63 per cent., and the enormous increase at 75 per cent. relative humidity.

In Figure C, total corrosion (*i.e.*, the value obtaining when the time-corrosion curve has "flattened out") is plotted against percentage of sulphur dioxide in the atmosphere. The influence of humidity is shown by the respective curves; but the point to which attention is now drawn is the minimum corrosion value in the neighbourhood of 1·0 per cent. sulphur dioxide (further work fixed the precise value at 0·85 per cent. SO_2).

Interest attaches to the fact that the corrosion product is associated with excess of sulphuric acid to the right of the minimum, and with excess of base to the left, while at

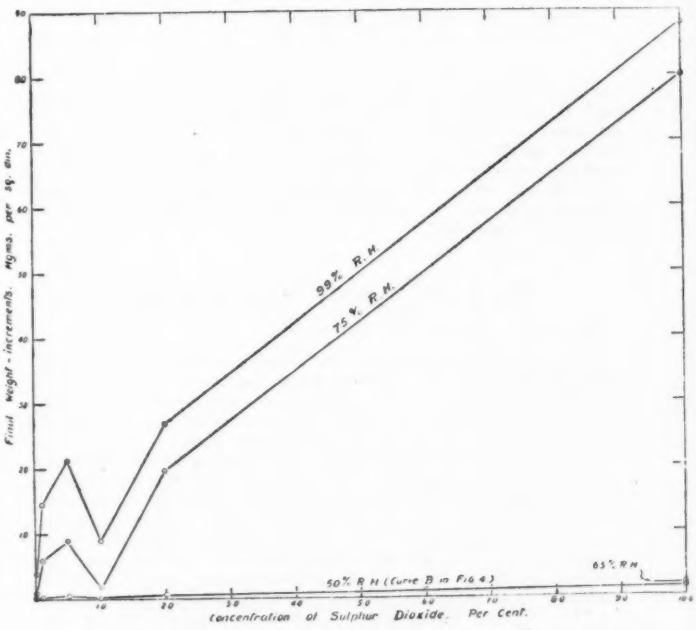


FIGURE C.—*Relation between Corrosion (Copper in Synthetic Atmospheres) and Concentration of Sulphur Dioxide.*

the minimum point itself it consists entirely of normal copper sulphate. This phenomenon would appear to have some bearing on the results recorded in the present report. Presumably a similar effect would be obtained with metals other than copper; but the critical concentration of sulphur dioxide would be expected to be influenced profoundly by temperature and by the metal used in the test; there is evidence, for example, that with nickel* at ordinary temperatures, the position of the minimum point is moved substantially to the left.

A concluding reference may be made to the influence of

* W. H. J. Vernon, J.Inst.Metals, 1932, **48**, 121.

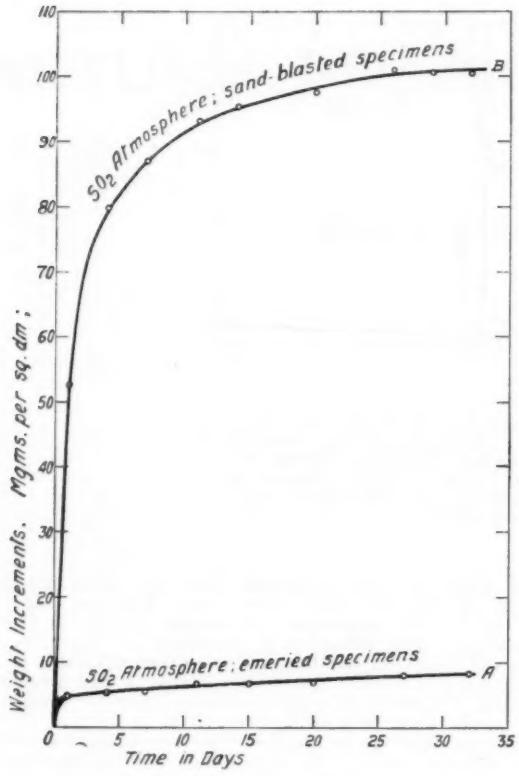


FIGURE D.—*Influence of Surface Condition (Copper in Atmosphere containing 1·0 per cent. Sulphur Dioxide, 99 per cent. Relative Humidity) upon rate of attack.*

surface condition in the purely physical sense. Curves A and B in Figure D show the enormous difference in behaviour, in atmospheres containing sulphur dioxide, of copper specimens prepared by rubbing with emery paper and by sand-blasting. Clearly it is of the highest importance, in any series of comparative tests, that the specimens employed should be as nearly alike as possible in respect to surface condition.

Mr. J. W. Wood's Written Reply.

Mr. J. W. WOOD, in reply, wrote:

The parallelism between the results of our experiments and those upon atmospheric corrosion mentioned by Dr. W. H. J. Vernon at the meeting is most interesting, although the lowest concentration of sulphur acids used in our experiments must have been many times greater than those normally encountered in researches upon atmospheric corrosion; this, together with the considerable amount of condensation of water may account for the large proportion of soluble copper salts in one condensation, rather than the formation of insoluble basic copper sulphate on the tubes. Experiences with higher concentrations of SO_2 are described by Dr. Vernon in a supplementary written contribution. The marked effects upon corrosion of variation in the degree of humidity of the air, established by Dr. Vernon, furnish a useful indication of the kind of result that may be anticipated in corrosion experiments where only partial condensation is attempted. The case of aluminium is the only one in the present series of experiments in which consideration of the density of the metal seriously modifies the interpretation of the corrosion values given on a weight basis, and the difficulty is specifically mentioned in the report.

Our experience with tin coatings is in accord with that of Mr. Masterman—namely, that commercial tin coatings are frequently less satisfactory than would be deduced from the present series of experiments—and attention is directed in the report to the desirability of improving the technique of applying such coatings. Except in the case of the iron tubes, no difficulty was experienced in our experiments from a reduction of draught by stoppage of gasways with accumulation of corrosion deposits, but the nature of deposits is clearly of practical importance, as was stressed in several instances in the 33rd Report. The noteworthy reduction in the rate of corrosion when the sulphur content of the gas is reduced below 10 grains per 100 cu.ft. is most interesting, and it is hoped that the experiments now in hand with gas of reduced sulphur content will confirm Mr. Masterman's findings. The extended field available for the development of gas appliances if the unpleasantness due from the smell of SO_2 and SO_3 can be diminished or altogether eliminated will be generally appreciated.

The results quoted by Mr. Singleton to indicate the manner in which the corrosion of lead can be influenced by the preliminary treatment of its surface are striking. In our experiments care was taken to secure freedom of the surface from grease, but no abrasive was used to remove, before starting the experiments, the tarnish formed by exposure of the lead to the atmosphere for some time. We were not specially interested in lead pipes, and as it seemed unlikely that 1-in. tubes would be obtainable so thin in the walls as was required for our experiments, building them up from sheet lead was regarded as a satisfactory alternative. It is believed further that the experiments were continued for a sufficiently long time for stable conditions of the surface to have been established. The possible deficiencies mentioned of tin-coated lead pipes may be of more importance in connection with gas distribution than in the present work.

The results submitted by Mr. A. B. Densham are particularly valuable, and their most important feature—namely, the relatively large decrease in corrosion below 10 gr. of sulphur—has already been commented upon in considering Mr. Masterman's contribution to the discussion.

In our experiments, conditions of maximum condensation were aimed at, and the condensates after formation did not run on to hot surfaces of metal, so that direct comparison of the two investigations may not be completely valid. In justification of the choice of 50 gr. as the sulphur content of the gas for one series of experiments, it may be pointed out that 25 gr. is at present frequently exceeded, and that it was desirable to go to a sufficiently high figure to render experimental error comparatively unimportant; doubling the initial sulphur content of the gas appeared to be reasonable in the circumstances. It has already been found impracticable to produce for experimental purposes a gas containing, say, 10 gr. of sulphur per 100 cu.ft. by direct treatment of the available town gas. It is, however, possible to reduce the sulphur content to a low value and then to bring this up to 10 gr. by the addition of carbon bisulphide, thereby providing an alternative to the production of synthetic mixtures, as suggested by Mr. Densham.

The reference by Professor Smithells to the Delhi Pillar provides a very apt and striking illustration of the importance of environment as a factor in determining corrosion.

The supplementary notes submitted by Dr. Vernon, together with the reproductions of the slides used at the meeting, form a valuable addition to the discussion. Considerably higher concentrations of SO_2 are used than in our tests, and the idea of a "critical humidity" is of interest. It should not be forgotten that the influence of a small amount of corrosion product, once formed, together with some SO_3 produced by oxidation of SO_2, may result in "moist" conditions at the surface of specimens even though the relative humidity of the atmosphere indicates that we are well above the meteorological dewpoint for the temperature of the experiment.

The continuous removal of the corrosion product in the condensates of our experiments will account for some of the differences between Dr. Vernon's results and our own, and a minimum rate of corrosion in the neighbourhood of 1 per cent. SO_2 is scarcely to be expected under fully condensing conditions. Figure D brings out very well the great importance of surface condition as a factor influencing corrosion.

The deficiencies pointed out by Dr. U. R. Evans of a simple statement of loss of weight for expressing the results of a corrosion test are admitted, but it has hitherto been difficult to find an alternative way of expressing the results quantitatively. Even when microscopic examination is used—and in the present experiments it did not prove particularly helpful—the difficulty of giving quantitative expression to the results still remains. The "index" of Herzog and Chaudron therefore seems to be attractive.

Dr. Evans may be assured that a considerable amount of work has been done within the Gas Industry upon the effectiveness of hoods, canopies, flues, and anti-back draught devices or "bafflers." Even with such devices, however, the problem of corrosion of the gas appliances themselves demands attention, and, moreover, it is frequently necessary to use appliances without attachment to flues. The suggestion of an automatic device to give warning of defective flue conditions is novel.

Communication No. 103—25th Report of the Refractory Materials Joint Sub-Committee.

Reply to the Discussion.

Mr. A. T. GREEN: The work associated with the annual Report of the Refractory Materials Joint Sub-Committee is a most important feature of the B.R.R.A.'s activities. Colonel C. W. Thomas and Mr. F. West, the Chairman and Vice-Chairman of the B.R.R.A., have spoken of the Association's new venture in providing and equipping the Mellor Laboratories. As a member of the staff, I have heartily welcomed the change, for it must considerably increase the efficiency of the research activities.

Mr. West surveys the implications of this year's report in an admirable manner. His reference to the testing of the adhesion of cements in vertical joints is a very important practical point, which we shall use in future investigations. I am aware of the necessity for further investigations on the thermal properties of refractory material and intend to proceed with this work at an early opportunity.

Mr. Rhead has again given us the results of his valuable experiences and has clearly indicated some of the difficulties encountered by the Joint Sub-Committee in drawing up the specifications for refractory materials, particularly respecting the texture of these products.

Mr. Rhead's remarks on the laminations noted in retort materials vindicate the work reported in our earlier papers on permeability. In future work concerning the flaking of silica materials in vertical retorts we shall avail ourselves of the explanations offered by Mr. Rhead based on the curvature noted in pieces of scurf. I would point out that this feature of the behaviour of scurf has already been noted in our plant investigations.

Mr. Curtis lays stress on the importance of a rational assessment of the service value of refractories in retorts. I agree that the comparison of the actual number of days worked by settings is in no way a true guide. Other factors—mentioned in the discussion—must be taken into consideration. The difficulty, however, lies in the formulation of an adequate basis of comparison. The data reported in the digest of the replies to the questionnaire on this point serve the useful purpose of showing how misleading can be the information concerning the life of a retort.

I agree wholeheartedly with Mr. Edwards' statement that the correct interpretation of the fluxing of refractories in horizontal retorts is of considerable importance, and I have carefully noted his comments for future reference. Unfortunately, our digest of the answers to the questionnaire is necessarily concise. I hope at a later date to be allowed to deal more completely with these answers and thus to add materially to the accuracy of the impressions obtained from it. It is known that iron compounds are transferred by volatilization from the charge to the brickwork of a retort. I have mentioned this fact in other papers on refractory materials in vertical retorts presented to the Institution. In blast furnace practice there are also definite examples of the volatility of iron compounds. About ten years ago, the late Dr. Weyman, of Newcastle-on-Tyne, was particularly interested in this problem and let me see the results of experiments which he had conducted, proving that iron compounds had been transferred to a refractory brick by volatilization.

Professor Cobb was early responsible for researches on the effect of alkalies on refractory materials, so that his contribution to the discussion is all the more interesting. His experience, particularly concerning the effect of temperature on alkali attack, substantiates the results of our experiments.

Communication No. 101—Controlled Operation of a Carburetted Water Gas Plant, Part I.; Factors Influencing the Performance of the Plant (35th Report of the Joint Research Committee of the Institution and Leeds University).

Dr. R. H. GRIFFITHS (Gas Light and Coke Company) wrote: Although we are promised a thorough discussion of all these results in a further report, I cannot resist the temptation of attempting a very brief comparison with the performances of water gas plants which have been previously described. In order to do this concisely, some basis of comparison must be agreed upon, and although there is no single figure which will tell us everything about the plant, the position is not quite so difficult as it might appear at first sight.

Taking the thermal yield from 1,000 lbs. of coke as the criterion of efficiency we are still ignorant as to the rate of gasmaking or as to the consumption of steam, but if the output is normal and the plant is self-supporting in steam, a direct comparison can be made on the basis of gas yield from coke.

The three series of tests on air/steam ratio, alteration of the cycle and change in blast pressure may be considered along these lines. How do the results fit in with our preconceived ideas? The three factors are practically inseparable, as they all affect the total quantity of air and steam which enters the plant. We know that the ideal to be aimed at is the most rapid storage of sensible heat in the fuel bed, with the minimum loss of potential and sensible heat during the blow, and the most complete and rapid decomposition of steam during the run. If the ratio of steam to air is lower than it should be, losses in blow gas will rise very rapidly and changes on a hand operated set with a cycle of 7-8 minutes will be more pronounced than on an automatic set with one of about 3 minutes.

The data of the present report entirely support these ideas, and show that low efficiencies occur with high air/steam ratios on account of bad quality blow gas, which is reflected in excessive steam raising by the waste-heat boiler. The rate of gas production is also diminished owing to the reduced rate of steaming.

When changes are made to the cycle, the effects are similar because again the dominant factors are the quality of the blow gas, the rate of gas making, and the quantity of undecomposed steam in the blue gas.

The present results at first appear to be exceptionally high, but it must be noted that they are expressed on a dry-coke basis, and that the highest figures are always accompanied by a deficiency of steam or by a decreased output. Some recently published figures obtained on the works of the Gas Light and Coke Company have been calculated to a dry coke basis, and are as follows:

	Therms/1,000 Lb.
Hand-operated sets, approximately	80
Self clinkering sets, without back-run, approximately	72
Self-clinkering sets, with back-run, rich gas, approximately	72
Self-clinkering sets, with back-run, poor gas approximately	80

It therefore appears that results can be obtained with hand-operated sets which are as good as those given by self-clinkering sets making gas of low calorific value, and better than the latter when making rich gas. The yields are also comparable with those of the present report in all cases where the plant is self supporting in steam.

If the blow gases from the water jacketed generator are properly mixed and properly ignited in the carburettor, there should be sufficient heat available under any normal conditions of enrichment, without prolonging the blow. The efficiency of the blow period is much less than that of the run, so that any improvement in the blow will have the greater over-all effect. The loss in blow gases can only be reduced by decreasing the potential heat—that is, by keeping down carbon monoxide to the minimum, or by reducing sensible heat. For a given fuel bed temperature, sensible heat losses can only be diminished by decreasing the actual quantity of blow gas.

If instead of raising steam by cooling the walls of the generator we were to preheat the air, this would return heat to the fuel bed during the blow instead of during the run, and would shorten the duration of the blow. It therefore seems likely that some kind of air-cooled rotary grate generator combined with the back-run process will give the highest possible efficiency in carburetted gas production.

Mr. C. S. SHAPLEY (Leeds) wrote: One of the most outstanding features of this report is that out of the mass of experimental data representing a tremendous amount of planning and work, the authors have been able to condense it to a summary which for clarity and practical usefulness maintains that high standard which has characterized their previous communications.

While one can agree with their conclusions that the per-

formance of a water gas generator is considerably influenced by the fusion point of the ash of the fuel being used, I would suggest that other conclusions can be drawn from the experimental data supplied.

It would appear that the depth of the clinker bed played a considerable part in determining the performance of the generator. Was the depth of the clinker bed measured in any of the experiments carried out?

As the speed of the grate decreased, the CO_2 in the blow gases increased, although it is also stated that the temperature of the gases leaving the top of the generator was lower, which is rather unexpected. A decrease in the grate speed would increase the depth of the clinker bed. There will be a critical depth of clinker for best results which will be limited by the radius of action of the automatic clinkering device. For example, should the clinker build up so that the main combustion face of the fuel is outside the range of the clinkering device, one would expect the uninterrupted formation of clinker with a consequent reduction of openings to the fire. High temperatures due to the increased local velocity of the air blast would occur causing a lowering of the CO_2 content of the blow gases as in Test 52. In Test 31 with the grate at optimum speed which gave the best results, I would suggest that the maximum depth of clinker which would still allow the clinkering device to break up the combustion face of the fuel had been reached. It is my opinion that the clinker, with its small percentage of combustibles present, is brought up to a combustion temperature on the back run of the cycle. The air blast passing through this bed is degraded and has its oxygen content reduced before reaching the main bed of coke. These conditions would not be favourable to local high temperatures favourable to CO formation, consequently more heat is left in the generator with a more uniform heat distribution.

I would suggest to the authors that probably grate speed control is of equal importance with regard to the working of a generator as the physical characteristics of the ash in the fuel.

Mr. H. J. Toogood (Crowthorne) wrote: Just exactly as this Report emphasizes the limitations of water gas manufacture, at present imposed by the conditions of practice, so does the Institution Gas Research Fellowship Report, 1931-34 (Communication No. 104), emphasize the "Great Hope of the Future," can we but reap a portion of that 100-fold acceleration of the reactivity to carbon dioxide of cokes at a higher temperature than the present-day practice.

I would inquire of the Authors (who alone can be expected to possess a balanced view of the relative importance of the very many factors set forth in the Report): (1) Would experiment show that the more reactive portions of the coke actually gasify at an early stage, so that eventually the less reactive coke gravitates towards the bottom of the fuel bed? If so, then this process of stratification or filtration of the fuel bed, into horizontal cross-sections of descending and decreasing reactivity would seem to be advantageous, as such formation would appear to temper the fuel bed to the rigours of the blast, by offering the cross-section containing the most refractory cokes to the maximum blast, of highest oxygen content, and consequently the hottest zone, whence, other factors remaining, the general temperature would be raised just those few degrees which mean so much, and a general quickening of decomposition set up to enhance efficiency.

(2) If such a process be deemed advantageous, would not a still greater advantage accrue if this fuel formation be encouraged or amplified by feeding the generator simultaneously with two widely differing classes of coke—viz.:

(i) Light continuous vertical retort coke, for its early reactivity to carbon dioxide and steam.
(ii) Dense intermittent vertical retort coke, made from cleaned coals (or retort carbon) for its later reactivity to generate the necessary heat with the minimum losses from clinker formation and fliers.
(iii) A possible future modification of the plant whereby the two fuels could be fed more directly to their respective zones?

Dr. F. J. Dent's Written Reply.

Dr. F. J. Dent, in reply, wrote:

The way in which the report has been received, and particularly the contributions to the discussion, are a complete justification of the time and labour expended upon it. I am asked to express the thanks of the Committee to the contributors and to Mr. A. G. Glasgow for his letter of appreciation.

In the discussion Mr. Grogono stresses, and rightly so, that the most important conclusion to be drawn from the tests is the interconnection between the efficiency of the plant and its rate of working. Operating the plant at high capacity under conditions which do not necessitate it leads to a high cost of raw materials per therm C.W.G., which will in many cases more than counterbalance any saving in labour brought about by the high rate of gas production.

The desirability of making the best possible use of the heat in the blow gases, a point also referred to by Mr. Grogono, is especially important in view of the increase in generator efficiency which can be obtained by reducing the proportion of the time used for blowing. The savings obtained by shortening the blow are effected to a considerable degree by the fall in the temperature of the blow gases leaving the generator and hence in their sensible heat content. When the blow gases enter the carburettor at a low temperature, the maintenance of the desired conditions in the chequerwork is more dependent on the efficient liberation of the potential heat from the gases by proper mixing and regulation of the secondary air supply.

Mr. Grogono calls attention to the fact that, in Tests Series 3, on the relative duration of blow and run, when the blow period formed less than 42 per cent. of the cycle, the plant ceased to be self supporting in steam. In view of the importance of the plant meeting its own steam requirements when steam cannot be applied cheaply from an independent source, it may be pointed out that the deficiencies in steam, observed at shorter blow periods, could have been avoided if a high air/steam ratio had been used. Raising the air/steam ratio would reduce the therms B.W.G. per 1,000 lb. of coke, but the quality of the gas would improve and, when a high output is not required, the procedure is more economical than avoiding the deficiencies in steam by using a long blow period.

We are indebted to Dr. King for making his results available to us—they will be of considerable help in drawing the final conclusions from our own figures, particularly so since, as Dr. King himself points out, he has studied some of the factors under conditions which differed from those of our own tests.

Dr. King refers to the complexity of the water gas process and the difficulty of discussing the influence of different factors on it. It is, however, a difficulty which has to be met, and it will be appreciated that in such an investigation as that described in the present report it is essential, while studying the influence of one variable, to standardize other conditions. The choice of the standard conditions depends largely on opinion and also on the direct use to which the results are to be put. Thus, for example, in studying the influence of the size of coke we operated with a constant blast pressure and in all cases adjusted the steam supply to give blue water gas of the same quality. These conditions were chosen as, on a plant of the type tested, the presence of the water seal places an upper limit on the blast pressure which can be used, and, as a consequence, the increased resistance thrown by a fuel bed of small coke has the important practical result of restricting the rate of air supply. The preparation of blue gas of the same quality avoided complications when considering carburetting up to a given calorific value. On the other hand, Dr. King gives figures for the influence of the size of coke, obtained on a plant which permitted the use of higher blast pressures with the small coke and, consequently, the maintenance of the same rate of air supply.

Influence of Coke Sizes.

The question as to which of the two bases of comparison is the more fundamental does not arise, since no single set of standard conditions will give figures showing directly the relative advantages of large coke; these are dependent upon the circumstances under which the plant is operated.

Considering the experiments of the present report, under the conditions of test, when the size of coke diminished decreases were observed in both the thermal yield of B.W.G. per 1,000 lb. of coke and in output, but, from the results of Tests Series 3, it follows that the extent of either of these losses could have been reduced at the expense of the other. The circumstances in which the output of the plant was not of primary importance, as high a thermal yield of B.W.G. could have been obtained, at least from some of the small grades of coke, as from the large. On the other hand, it is clear from the results in Table 2 that if it is practicable to use a higher blast pressure with the smaller coke, the loss of output observed can be counteracted.

Moreover, when comparing the use of different grades of coke, under conditions which lead to a higher thermal yield of B.W.G. being obtained from the large coke, it was found, as would be anticipated, that with the higher yield of gas there was less heat available for oil cracking and steam raising. Circumstances may arise in which the smaller quantity of heat is insufficient to meet the requirements of these purposes, and then the higher thermal yield of B.W.G. would have to be sacrificed, probably by modification of the air/steam ratio as in Tests Series 3.

If, however, no single series of tests carried out under standard conditions can give figures showing the influence of a given factor in all circumstances, it is important to be able to appreciate the limits imposed by the conditions chosen. In the present investigation it will be seen that the conditions standardized for the study of one factor become the variables in other series of tests, and by considering the investigation as a whole, the influence of the various factors can be more fully realized.

Unless this interconnection between the various tests is taken into account, the results obtained in the individual series can be directly compared only with results obtained under the same conditions. It is pointed out here that, from such data as Dr. King could give us in the short time available at the meeting, it appears that his experiments confirm those described in the report if allowance is made for the differences in the standard conditions used. More detailed comparison of the two investigations will not be given at this stage, as we hope to have the opportunity at a future date of considering the complete results of Dr. King's experiments.

Dr. King also refers to the expression of the thermal yield of blue gas per 1,000 lb. of dry coke. We think the expression is justified in a report dealing with the practical operation of a water gas plant, so long as gas is sold on the thermal basis and coke on the weight basis, and the same applies to the expression of steam quantities in pounds and oil quantities in gallons. All the thermal yields of B.W.G given in the report are, however, expressed in terms of dry coke of the same composition, the latter corresponding to a calorific value of 13,050 B.Th.U. per lb. The figures representing the thermal yield of B.W.G. per 1,000 lb. of coke can be readily converted to the basis suggested by Dr. King—viz., therms B.W.G. per 100 therms of coke, by dividing by 1·305.

Ash Content.

In connection with the remarks made by Dr. King with regard to the ash content in the different grades of coke used, it should be pointed out that, while the ash content of the different grades did vary, all results are given in terms of coke of the same composition, and such variations do not interfere with the direct comparison of the results reported.

Mr. Hollings amplifies the conclusions given in the report, and I am in complete agreement with his remarks. He points out that the price of 2s. 4d. per unit assumed as the minimum for surplus steam from an independent source will seldom be attained on works using intermittent systems of carbonization. In view of this, it is noteworthy that even with additional steam at this low price, the cost of raw materials per therm C.W.G. was not reduced by using lower air/steam ratios than that at which the plant was just self-supporting in steam. Looking at the question of steam raising on the plant from another view-point, it appears that although, by plant adjustment, it is possible to reduce the amount of heat entering the waste-heat boiler to a minimum, thereby increasing the thermal yield of B.W.G. from the coke, it is not economical to do so if the procedure results in the plant not being self-supporting in steam.

The results do indicate, as suggested by Mr. Hollings, that it may be profitable in certain circumstances to use exhaust steam from auxiliary plant as part of the supply to the generator.

Dr. E. W. Smith emphasizes the value of the interpretation of test results on an economic basis. The importance of this is clear from the fact that the measurements to be made in order to obtain data for costing a process may differ considerably from those required for the derivation of its thermal efficiency. It is appreciated that it is not possible to give a definite figure for commercial efficiency in the same way as for thermal efficiency, in view of the dependence of the former on prevailing local circumstances. It is possible, however, and it is thought desirable, to express test results in the form required for use in economic calculations, and, moreover, an appreciation of probable economic conditions enables more pertinent data to be selected for measurement.

With regard to the present report, the carburetted water gas process offers a peculiar complexity—a result, on the one hand, of its use of raw materials which differ considerably in monetary value, and, on the other, of its position as an auxiliary to coal gas production. As stated by Dr. Smith, the full significance of the results in the report will not be obtained without collaboration with men well versed in the economic side of the Industry.

A System of Plant Control.

Mr. Terrace remarks on the purpose for which the tests described in the report were made—viz., to serve as a guide in the evolution of a system of plant control. According to circumstances, the amount of labour which can be profitably employed in taking observations, &c., will vary, and in proposing a system of control, the methods to be used will develop from the taking of spot samples of blow and waste gases up to a system permitting a complete analysis of the performance of the plant as set out in the tables of the report. In addition to these observations, however, the success of any system of control will depend to a considerable extent on the supervisor of the plant having a clear idea of its working, and for this purpose a more detailed discussion of the test results now presented and a comparison of them with those of previous workers should be helpful.

The comparison will be included in a later report and will be on a somewhat broader basis than that given in the discussion by Dr. Griffith, who considered hand operated and self-clinkering sets from the standpoint of the thermal yield of B.W.G. per 1,000 lb. of coke. A comparison of these two types of plant solely on this basis does not seem to be a rational procedure, since the primary aim of self-clinkering generators is to reduce labour costs. It does not appear to justify a conclusion that "results can be obtained on hand clinkered sets which are as good as those given by self-clinkering units." Much plainly depends on the interpretation placed on the word "results."

There is no doubt that in modern plants the figures given by Dr. Griffith can be exceeded. Dr. Griffith suggests this himself, since, while stating that sufficient heat is available in the blow gas for any normal conditions of enrichment, he quotes figures for coke consumption when making rich and poor gas of 72 and 80 respectively. The difference between these figures indicates that operation of the plant has been restricted by inefficient combustion of the blow gases.

As our next report will contain a review of the test figures now available, I would like to postpone the detailed consideration of the results put forward by Dr. Griffith.

Effect of Varied Grate Speeds.

Mr. Shapley's contribution deals with the influence of ash and clinker accumulated at different grate speeds, and this may very well be as he describes, but when the grate speed was altered, other changes took place to which attention can be drawn.

At slower grate speeds there was an immediate possibility of increasing the proportion of steam supplied in the back-run, and, indeed, this was necessary if condensation of the up-run steam was to be avoided. When using larger proportions of steam on the back-run it was found, by immersing a poker in the fuel bed, that the distribution of temperature through the latter had altered considerably. The fuel bed had originally been at a relatively uniform temperature throughout its depth, but there now appeared a high temperature zone, 1 ft. to 1 ft. 6 in. deep, at approximately 6 in. above the grate. This redistribution of temperature will very probably be intimately connected with the changes observed in the composition and temperature of the blow gas leaving the generator, and there is no doubt that, as suggested by Mr. Shapley, the joint control of grate speed and back-run steam, in order to obtain the best temperature conditions in the bed, is very important.

In view of this, Mr. Tomlinson's remarks with regard to the Humphreys & Glasgow improved method of grate control are particularly interesting. I have had no direct experience of this modified control, but have noted the favourable impression it has made at those plants on which it is used. After making the tests at Croydon, we are undoubtedly of the opinion that a more precise method of grate control is desirable. We found it difficult to maintain the grate speed at its optimum when the only guides to adjustment were the indications of the back-run pyrometer and the inspection of the fire. The difficulty was especially marked when fuels were used with ashes of varying fusion characteristics, and it is thought that under such conditions grates are often operated at too high a speed in order to avoid mechanical trouble, but this procedure incurs the considerable losses indicated in the report. It was found that adjustment of the grate was somewhat easier when the plant was equipped with a pyrometer in the top gas outlet of the generator, since, when other conditions were the same, the temperature indicated by the pyrometer increased if the accumulation of clinker became excessive. An improved method of control will undoubtedly facilitate the maintenance of higher efficiencies.

During the tests, the coke supplied to the generator came via the screening plant, direct from the retort house. At no time during our stay at Croydon was it possible to control the nature of the coal carbonized, and unfortunately we could not follow Dr. Lessing's suggestion of determining the effect of using a coke with a minimum ash content.

The readiness with which a fuel produces clinker is a

major factor in determining its suitability for water gas manufacture, and interesting results would have been obtained from tests showing how far this property depended on both the percentage and fusion characteristics of the ash.

As indicated, the opportunity for such tests was not forthcoming, but there remained the necessity of preventing accidental variations in the nature of the ash in the cokes which were used, from interfering with the study of other factors. This was accomplished by making a large number of tests and taking the mean of the results obtained, using a graphical method.

With regard to Dr. Lessing's final remarks, the investigation of the quality of the coke ashes is now proceeding.

Mr. Toogood views the manufacture of water gas in the light of the Institution Gas Research Fellowship Report and asks whether, in the lower parts of the fuel bed, the reactivity of the coke is less owing to a heterogeneous nature leading to preferential gasification. Much of Professor Cobb's work on reactivity has given information on changes in this property as gasification proceeds, as to the manner in which these depend on surface films, the extent and availability of the surface and heterogeneity in the coke substance. From the results of his experiments it would be surmised that, while preferential gasification may occur, the extent of changes in reactivity due to this cause is insufficient to have an important influence on the working of a water gas generator. Later in his contribution, however, Mr. Toogood speculates on the possible advantages of purposely exaggerating such effect by supplying simultaneously two cokes of widely differing reactivity. Without regard to the design of a plant permitting the procedure, it appears that the success of the process would depend on controlling the flow of gases so that, while the benefit of the layer of high reactivity was obtained during the steam run, an excessive amount of carbon monoxide was not produced during the blow. These are similar aims to those of the Kramers and Aarts process, in which, as will be remembered, a longer time of contact between steam and coke of effective reactivity was obtained by using two fuel beds, in parallel during the blow and in series during the run.

Communication No. 104—The Reactivities to Carbon Dioxide of Cokes and Other Forms of Carbon at High Temperatures—Gas Fellowship Report, 1931-34.

Mr. T. F. E. Rhead (Birmingham) wrote: The value of this fundamental research work being carried out at Leeds will be more and more appreciated by the Gas Industry as time progresses.

Leaving out the possible catalytic action of ash, it can be stated that in this work we are dealing with the resultant effects of two groups of factors:

(1) Those associated with surface chemistry, and
(2) Those associated with the nature of the carbon molecule.

It is extremely difficult to disentangle the separate effects of these groups, and to decide where the borderline lies—if such borderline there be.

Gas technicians are more familiar with the first group having a good conception of the effect of size of lump, and size of pore. We are, however, less familiar with the effect of molecular structure. Ephraim, in his very excellent treatise on Inorganic Chemistry, points out that we are apt to look on carbon as existing in three well-defined allotropic modifications: Diamond (cubical crystalline), Graphite (rhomboidal crystalline), and Amorphous Carbon (non-crystalline). We are probably correct with respect to diamond, which the physical chemist has shown to be composed of molecules consisting of a three-dimensional grouping of carbon atoms, but incorrect as concerns graphite and amorphous carbon. These latter materials may have the same kind of molecule and the difference in properties be due to symmetrical or unsymmetrical groupings of this molecule, and if this is so the varying properties between different graphites and carbons is simply another manifestation of the effect of surface—in this case molecular surface, whereas previously we were dealing with geometrical surface.

Ephraim reminds us that graphite is shown by X-ray analysis to have an orderly or crystalline structure and to be largely composed of carbon molecules possessing a two-dimensional grouping of carbon atoms which imparts to the crystal its familiar leaf-like structure.

Amorphous carbon may be simply an unsymmetrical or disorderly grouping of the same molecule. This theory allows for a wide range of mixtures of graphitic and amorphous groupings and explains the large variation in properties of graphites and carbons.

It is well known that the nature of the surface on which molecular carbon is deposited appears to determine whether it will assume a graphitic or amorphous structure—*e.g.*, Ephraim states that methane carbon deposits in graphitic form on a smooth surface but in an amorphous form with a rough surface. Temperature also has an effect.

The higher C.V. of charcoal, compared with graphite, is probably due to its larger surface energy. Retort scurf seems to be composed of varying mixtures of graphitic and amorphous carbon.

Cokes from very fusible coals are usually less reactive than those from less fusible coals. The walls of the pores are composed not only of the residual carbon from the decomposing compounds, but in many cases this carbon is extensively layered over with carbon deposited from decomposing hydrocarbons, and if this is graphitic the reduced reactivity would be explained as being due to a low degree of molecular surface.

From the above statements it would appear that this invaluable reactivity research cannot proceed much further without making use of such valuable tools as X ray analysis, and extremely careful calorific value and specific gravity determinations. It may also be possible to fractionate the mixtures of graphitic and amorphous groupings in cokes, scurfs, &c., by such means as electrical pulverization, grinding, froth flotation, gravity separation, &c. Further information may be forthcoming from Sinnatt's Cenospheres with their transparent carbonaceous windows.

In manufacturing processes using coke, lump coke is usually desirable to reduce expensive back-pressure, poor reactivity is often counterbalanced by making the plant large enough to ensure sufficient time-contact to allow the desirable percentage of fruitful molecular collisions. This of course means increased space and capital outlay, hence the need for thoroughly investigating the factors influencing reactivity.

Mr. R. A. Mott (Sheffield University) wrote: This contribution to our knowledge is welcome as the first British work which shows the change of reactivity of coke and other materials with increase in temperature to 1,500° C. The confirmation that, at the high temperatures and relatively long time of contact in a blast furnace hearth, all cokes will give complete reduction of CO_2 to CO, and differences in reactivity are not likely to influence the possible rate of driving a furnace, is welcome. It may now be held to be established that the views expressed about 10 years ago, regarding the desirability of reactive coke for blast furnaces, are erroneous, and I particularly welcome the exposition of the error in Korevaar's so-called law of heat compression.

The experimental evidence that differences in reactivity may persist to temperatures of 1,400° C. is interesting, though the ratio of specific reactivity of the cokes in Figure 6 is only about 3 : 1 at 1,400° C. compared with 100 : 1 at 900° C. The smaller ratio conforms better with practical knowledge of the behaviour of different cokes at high temperature.

The authors have rightly stressed the importance of time of contact, and it is possible that if a more accurate estimate of this were possible the experimental results would be even more valuable. The authors suggest a free space of 20 per cent. in a bed of coke particles but the space between the particles would more probably be 40-50 per cent. before gasification. Our work suggests that, in coke up to perhaps 1½ in. in size, the interconnected open pores of coke do form paths for the gases and, with the small size of coke used in the Leeds test I suggest that the free space could be considered to be all space between the particles and all open pores which may make the total free space about 75 per cent. The use of a good wetting medium such as alcohol would give the void space *in situ* in the tube, to which should be added the percentage of open pores. To obtain the average free space during a test one should have a determination of the "free space" at intervals, for with two cokes originally of the same free space, the more reactive will give a longer time of contact after gasification for, say, 1 hour because of the greater "free space" at this interval. I should like to have the opinion of the authors on the qualifying effect this might have on their conclusions.

With regard to the conflicting requirements in respect to reactivity of coke in the blow and the run periods of a water gas generator, one method of meeting this is to use a large size of reactive coke. Our tests suggest that with coke, of say, 3-4 in. size, the gases do not penetrate far

below the surface and the effective "free space" as well as the surface is much less than with small coke. In the oxidizing zone of the producer, however, the coke is finally reduced to a small size and can react rapidly with steam during the run, while the upper layers of large coke will not cause much decomposition of CO_2 to CO in the blow.

Written Reply.

Dr. T. H. BLAKELEY and Professor J. W. COBB wrote: It is evident that the possible application to water-gas manufacture of the results outlined in the Report is of general interest. The discovery of a coke which had a low reactivity to carbon dioxide and a high reactivity to steam would be a boon to operators of water gas plants, and the search for such a coke, as suggested by Mr. H. Hollings, is best commenced in the laboratory. The probability of success in the search is, however, not great. The 22nd Report of the Joint Research Committee* gives percentage decompositions of carbon dioxide and steam under standard conditions for 14 cokes from Notts., Yorks., and Durham coals. Within the limits of observation, the order of reactivity to steam is identical with that of reactivity to carbon dioxide. Furthermore, the reaction between steam and coke lacks the comparative simplicity of the reaction between coke and carbon dioxide, and is not as amenable to mathematical treatment. A possible way of attacking the problem would be to seek an inorganic material which catalyzes the steam-carbon reaction. Some work has been done on this point,† but none at the temperatures considered in the present report.

Dr. F. J. Dent's remarks on the possible application of the work in the improvement of the performance of the carburetted water gas plant are very interesting. The results are of immediate utility, because a reduction in the temperature of the fuel bed is not dependent on a difference in steam and carbon dioxide reactivities, but requires that both shall rise together. The net effect is to enable the water gas reactions during the run and the blow to be carried out at a lower temperature. The blue water gas would probably be of the same quality as that obtained with a less reactive coke raised to a temperature at which its reactivity equalled that of the more reactive coke. We are indebted to Dr. Dent for summarizing so well the advantages which are likely to accrue.

Dr. A. Key raises points of fundamental interest in the study of coke reactivity. Throughout the work we have always kept in mind the possible practical applications of our results, but at the same time we have considered the enormous volume of work which has been poured out during the past twenty years on theoretical aspects of the subject. There can be few more bewildering accumulations of results and conclusions. Numerous factors affect reactivity, and many workers tend to concentrate on one to the exclusion of others. Of these factors, two are connected with Dr. Key's remarks. These are the nature of the surface, and the surface area. The two are difficult to disentangle experimentally, many results existing which can apparently be explained by alterations either in the surface area or in the nature of the surface. The example quoted by Dr. Key is a case in point. The rising curve of Sharlston Wallsend coke S.W. 1 may be explained either by the gasification of an unreactive surface film, or by an increase in the surface area. The rejection of either of these explanations is not easy. In some cases, as for the heat-treated cokes, the unreactive film hypothesis seems the better; in others, such as graphite, an increase in surface area by surface etching seems more probable.

As pointed out by Mr. H. J. Hodsman, neither high reactivity nor low reactivity in itself denotes a superior coke. The properties of cokes must be considered in relation to their uses. The low reactivity of retort carbon at high temperatures is striking, and suggests that this material may have special applications, but the possibility of large variations in ash content may preclude its use for some purposes.

We welcome Mr. R. A. Mott's general agreement with our conclusions in so far as these relate to blast furnace practice, and wish to pay tribute to the work carried out at Sheffield University on this aspect of the use of coke. The persistence of differences in reactivity at high temperatures is rather more marked than Mr. Mott suggests. He has included the Black Vein coke in his consideration, but insufficient determinations were made on this coke for us to include it except as an example of an extremely unreactive coke. If this coke is omitted, the ratio of maximum to minimum specific reactivities for cokes from bituminous coals is 7 at 900° C., compared with 3 at 1,400° C.

The difficulty of evaluating contact time, which is closely related to the estimation of free space, is very great. Fortunately it is probable that errors in estimating free space in our experiments will be approximately parallelled by similar errors involved in a consideration of large scale appliances, and a rough correction will thereby be made. In deciding the probable effective free space, we considered that with contact times of approximately 1/10 sec. little opportunity was offered for gas to diffuse into and out of the coke particles sufficiently fast for the inner pore volume to have a serious effect. In such pores an approximate equilibrium is probably attained. For close-packed spheres the free space is 25·95 per cent. Cubical particles may pack more closely, and therefore the round figure of 20 per cent. appeared reasonable. If this figure is low compared with that of large coke, this will have the effect of making more important in practice the differences which we have shown to exist on the laboratory scale. (Mr. Mott's suggested figure of 75 per cent. for the free space, including pores, agrees closely with Dent's and Cobb's figure of 70 per cent., found by an alcohol immersion method.) We agree that gasification will tend progressively to increase the free space. In practice this effect will be largely nullified by the settling of coke under the weight of the charge above it. With most of our determinations at high temperatures, the reactivity fell off very rapidly at or shortly after the commencement of gasification, and the value we used was quickly attained. It is therefore improbable that our conclusions need qualification on this account, whether considered from the laboratory or large-scale standpoint.

Mr. Mott's suggestion for meeting the apparently conflicting requirements of water gas generators is interesting. It needs to be considered in connection with the temperature distribution in the bed, which will be affected by the nature of the cycle. If the temperature distribution were the same for the blow and the run, the increase in surface area per unit volume of the small coke at the base would affect equally the decomposition of steam in the run and of CO_2 in the blow. If by some variation of the cycle the hottest part were caused to be in the small coke at the commencement of the run and in the large coke at the commencement of the blow, this would help to the solution of the reactivity required for water gas purposes.

Mr. T. F. E. Rhead draws attention to two factors—surface area and nature of surface—which we have mentioned above in connection with Dr. Key's remarks. He rightly stresses the difficulty of separating these factors. A relevant contribution on this subject was made by Dent and Cobb,* in which the equilibrium in the system CO_2-CO-carbon was determined by a method resembling that used by Rhead and Wheeler in their investigation of this reaction. It was found that the composition of the equilibrium mixture, which was presumably independent of the surface area, was affected by the form of carbon. This indicated differences in the nature of the surface. The differences in surface energy thus shown are intimately connected with differences in the calorific value of the respective fuels.

* Trans. Inst. Gas Eng., 1928-29, **78**, 240-248.

† Institution Gas Research Fellowship Report, 1927. Sutcliffe, Branson, Dent, and Cobb, Trans. Inst. Gas Eng., 1926-27 pp. 333-402.

* J.C.S., 1928, 1903.

Variation in the Behaviour of Carbonizing Plants

The Author points to the difficulty of making any valid comparison between the performances of carbonizing plants owing to the number of variables which have to be taken into account.

By G. E. FOXWELL, D.Sc. (Lond.), F.Inst.F.

Gas engineers and coke oven managers, to say nothing of their Directors, are frequently disposed to compare the operating results of carbonizing plant. The comparison is made, for example, when some new plant is to be installed and is then instituted for the purpose of assessing the relative merits of competing systems. It is made, upon other occasions, by Directors who hold that because plant A is producing certain results, something is wrong with the management or system at plant B if equal results are not obtained. It is made, furthermore, whenever two or three are gathered together, for who has not heard the remark that "so-and-so is doing well; he is getting 90 therms from his plant"—and in most instances not even the calorific value of the gas is mentioned when making the comparison.

When plants are submitted to a formal test under *exactly* the same set of conditions, comparisons may be neither odious nor misleading. But apart from such obvious causes of divergence as difference in age, state of repair, and so forth, there are many reasons for wide differences in results which are unconnected with any of the factors it is sought to assess upon the occasions mentioned in the first paragraph. In this article only one of these variables will be considered—the character of the coal as charged into the retort or oven.

The assessment of carbonizing plant is of undoubted value. Correlation of the results obtained at one place under the conditions there ruling with the results at another place would be of value to the constructor who is endeavouring to discover the effect of some alteration in design that may have been made with a view to improvement of his plant, and it would equally interest buyers who have to interpret rival, and possibly conflicting, claims. At present these attempts at correlation are made by performing a test extending over an undefined period of time, in the course of which local differences may arise which mask the true results, and the figures obtained are then calculated to a standard. The standard may comprise more than one variable which must be taken into account when making the calculation, but of these the coal is nearly always one. The coal used generally differs from the "guarantee coal" in ash and water content, and the test results are calculated to these which would presumably be obtained if the "guarantee coal" had been used.

No Two Coals are Alike.

It is an elementary truth to state that no two coals are alike and that the gas-making qualities of coals differ. But how often this is neglected, not perhaps consciously, nevertheless certainly. Testing results are usually stated, it is true, to have been obtained on a particular coal, or mixture of coals, and so long as this reservation is noted the gas-making qualities of the coal are taken into account—by being left out of account! Frequently, however, when the comparison is made, not on paper but by the mental processes involved in interpreting the results, the nature of the coal is tacitly ignored. If working results obtained at different places are to be correlatable there must be some method of classifying coals upon the basis of their properties. The Geipert test, the Lessing test, the Gray-King assay, the Otto test, and others have all been designed to indicate these differences, but there is no standard method of evaluating the gas-making properties of a coal. The amount of volatile matter evolved as primary products from a coal when heated at a standard rate under conditions such that the products are not decomposed is an absolute characteristic of that particular coal. The decomposition effected in those bye-products when passed over a heated surface at a constant and defined rate is a more difficult, but equally assessable characteristic. It should therefore be possible to devise a method for evaluating the "theoretical" gas-making properties of coals so that the works results could be the better interpreted. This might be a suitable task for the workers at the Fuel Research Board. A possible alternative for value purely for special occasions would be to lay down certain coals as suitable for use when making guarantee and similar tests. This alternative is clearly open to many objections, but may be inevitable if the devising of the proposed test proves over-difficult.

Fuel Consumption.

To put the therm-producing properties of coals on a sound basis would, however, solve only half the problem. There yet remains the almost equally important factor of fuel consumption. This also depends to some extent upon the nature of the coal as charged into the retort or oven, and is not wholly a function of the design of the setting. Coals which give the same number of gaseous therms when tested in a standard apparatus may yet differ fundamentally, and in a manner which affects the fuel required for carbonization. It may be that a coal contains some 40% of volatile matter while another which gives an identical therm yield contains but 28%. The ash content may be the same in the two coals. Of the 40% of volatile matter, some 10% or 12% may be water of constitution and up to 4% by weight of the coal may be carbon dioxide, making the "useful" volatile matter only 24% or 26%. Of the 28% of volatile matter the water of constitution may amount to no more than 4% and the carbon dioxide to less than 1%, making 23% or 24% of useful volatile matter. Differences in tar yield and in the composition of the gas will result in the same yield of gaseous therms from each of the two coals. These two coals will behave differently. The difference of nearly 12% in the coke yield has this influence upon the fuel consumption required for carbonization that, whereas in the one instance from every ton of coal charged but 12 cwt. of coke must be heated to 1,000° C. and discharged red-hot from a static retort, from the less volatile coal no less than 14·4 cwt. of coke are discharged at the same temperature. The difference in heat units is 1·73 therms per ton of coal carbonized (77·3 B.Th.U. per lb.), or approximately 7% of the total heat required in an efficient setting. On the other hand, there is operating in the reverse direction the time taken for carbonization. It was formerly (in the days of comparatively low flue temperatures) a coke oven motto that the period of time required for carbonization was 1 hour for each 1% of volatile matter—a rule that was not greatly removed from the truth in those days. Certainly it can be taken as true that the lower volatile of the two coals selected for the purpose of the discussion will require but 70% of the time needed for the higher volatile coal with the same combustion chamber, or coke oven flue, temperature. Roughly equivalent amounts of the fuel per unit of time must be used in the two instances to keep the temperature of the heating surface at the same level, so that the fuel consumption will be reasonably equivalent to the time taken for carbonization. This factor more than equalizes the increased consumption of fuel needed to heat the coke from the lower volatile coal.

It is difficult to see how any allowance can be made for this factor either by standard preliminary methods of testing or by calculation. The difficulty is intensified by reason of a further, and as yet virtually unstudied, property of coals whereby the rate of transmission of heat through the several coals varies. This variation may be due to the difference in the plastic properties of the coals, and their behaviour in the vertical retort is certainly to be correlated with their plasticity, in a manner as yet numerically unknown. Although it is not easy to see how precise limits can be set upon these properties, it is clearly of importance that the volatile matter content of the coals should be stated when publishing the results of carbonizing installations, and when continuous verticals are under consideration some discussion upon the plastic properties of the coals, perhaps in the nature of a determination of the plastic curve, should also be given if the results are to be interpreted intelligently.

Considerable uncertainty is caused by the prevalent custom of calculating results to coal free from ash and moisture. About the ash content but little need be said. Clearly the greater the amount of ash, the less is the quantity of coal to yield gas. On the other hand, the ash may have a catalytic effect upon the gas yield and composition, so that the customary calculation neglects an effect of un-

known magnitude. The heat consumption of the ash, moreover, is not to be accepted as being solely in proportion to its amount. The composition, quantity, and specific heat must be taken into account. It is probably preferable to state the ash content and to leave it at that.

Moisture Content.

The moisture content is more difficult still. What is the effect of moisture upon carbonizing results? To what extent does the moisture in the coke oven, the horizontal retort, the continuous vertical retort, and the intermittent vertical retort affect the yield of gas? The effect will be different in each instance. In the continuous vertical retort the water comes off at a comparatively early period and then escapes without having come into contact with much of the hot coke. In the coke oven and the intermittent vertical the reverse happens and the water in part is only evolved towards the latter portion of the carbonizing period, when, coming into contact with hot coke or carbon deposits, it forms gas. The water vapour travels over the top of the coke in the horizontal retort, and here also may form permanent gas. These possibilities show that it is not necessarily correct to calculate out the moisture content of a coal even when considering only the gas yield.

There is, however, a yet more potent reason why results cannot be "corrected" for moisture. What is the effect of moisture upon the fuel consumption? The difficulty of answering this question in a general sense arises because there is more than one important unknown factor. As carbonization proceeds in a mass of coal, the gases are generally divided by the plastic layer into two portions, one of which passes outside along the hot coke, and the other, consisting of the low-temperature gases and vapours, passes inwards through the cold coal. The sensible heat of this latter portion will serve to evaporate part of the water contained in the coal. So far as can be ascertained this subject has not been investigated in gas retorts, but German coke oven investigations indicate that moisture equivalent to some 6% or 7% of the weight of the coal is evaporated by this inward travelling gas. According to the results obtained and opinions expressed by Baum and Koppers independently, some 6% or 7% of water can be present in the coal without any extra heat being required for its evaporation.

Greenfield, however, has examined the subject from the same angle of coke ovens, and has come to the conclusion that only some 2% at the most of water can be evaporated by the inward-travelling gases.

In view of these conflicting results a brief examination of the difficulties of the problem is instructive. The amount of gas passing inwards through the cool portion of the charge is variable both in absolute quantity and in the proportion it represents of the total gases generated from the coal. At the time of charging and for a short while after, all the gases pass inwards; thereafter only those gases and vapours pass inwards which are generated from the coal at temperatures up to and below the temperature of maximum plasticity—say, 430° C. in a South Yorkshire coal. The quantity of these products and the "partition temperature" will depend on the coal. The quantity of sensible heat available for the vaporation of moisture is therefore a function of the coal and is both variable and not known with accuracy. That is the first cause of uncertainty.

Experiment with a particular coal has shown that the quantities of gases passing inwards are, per metric ton of coal carbonized: 35 cub.m. of gas containing over 70% of methane and other hydrocarbons; 3% by weight of oil; 4% by weight of water of constitution. It may be supposed without serious error that these gases and vapours are generated at a mean temperature of 400° C. Since the temperature of the charge remains at 100° C. until all water has been evaporated, the available sensible heat is that which results from cooling from 400° to 100° C. The total available heat passing into the interior of the charge is thus found to be somewhat as follows (calculations being taken to the nearest 100 Cals.):

	Calories.
Gas – 35 cub.m. of specific heat 0·474	
Available heat = 35 × 0·474 × (400–100) . . .	5,000
Water of constitution—40 kg. steam of specific heat 0·5	
Available heat = 40 × 0·5 × 300	6,000
Oils—30 kg. of specific heat 0·5	
Available heat = 30 × 0·5 × 300	4,500
Of the 30 kg. about one-half, having a latent heat of 80 cals./kg., may be expected to condense on the coal, giving up 15 × 80 cals.	1,200
Total available heat	16,700

What happens to this heat that is carried into the cool centre of the charge? If it is all used to evaporate water, the total heat in water from 20° C. raised to 100° C. and converted into steam being 617 Cals./Kg., the total water that can be evaporated is given by the fraction 16,700/617, or 21·7 Kg.—namely 2·17% of the weight of coal carbonized. Baum's calculation confirms this by showing on his assumptions that the amount of water evaporated by the inward-flowing gases is from 2·5% to 3%, while Greenfield arrives at a figure of "at the most 2%."

Functions of Inflowing Sensible Heat.

All these calculations ignore one of the obvious functions of the inflowing sensible heat. The quantity of heat just calculated, 16,700 Cals., is derived from one metric ton of coal. Since the internal temperature of the charge is 100° C., clearly the raising of the coal from 20° C. to 100° C. may be largely effected by the sensible heat of the gases. The heat required for this purpose is 1,000 × 0·25 × 80 = 20,000 Cals., or more than the total available heat! Is any of the moisture evaporated by the sensible heat of the gases? It is not known to what extent the interior of the particles of coal must be heated up to 100° C. before the moisture lying on the surface is evaporated. This is the second cause of uncertainty.

On the basis of calculation and reasoning it appears that the amount of moisture that can be evaporated by the sensible heat of the inward-flowing gases is not more than 2% to 3% of the weight of the coal and is probably well below 1%. Nevertheless, Baum maintains on the basis of plant data that "the heat of carbonization reaches a minimum when the coal contains between 6% and 8% of moisture." Koppers claims experimental (plant) evidence that the addition of 6% to 8% of water does not affect the heat required for carbonization. It may be that, as he believes, some of the gases from the hot zone penetrate the plastic layer and pass inwards. Clearly, if this be true, the amount penetrating must depend on the resistance of the plastic layer, and, therefore, on the nature and size of the coal—yet another uncertainty!

To calculate the results of tests to a moisture-free basis obviously involves many assumptions devoid of any sure basis, and in the present state of knowledge is indefensible.

The apparent discrepancy just disclosed has been correlated by Greenfield in a paper read before the Coke Oven Managers' Association, 1934, with the known relationship between the moisture content and the bulk density (weight per c.ft.) of a coal. The bulk density passes through a minimum when the moisture content of the slack is between 6% and 10%, the precise value depending on the size and grading of the coal. Clearly the heat to be supplied per square foot of heating surface of the oven wall or gas retort will depend on the amount of coal to be heated—*i.e.*, on the bulk density of the charge. Calculation upon these lines produces curves of the same shape as those of Baum. Greenfield believes that in the work of Baum and Koppers the effect of moisture content upon the heat consumption for carbonization has been confused with the effects of bulk density. Be that as it may, the moisture content and grading of the coal clearly affect the performance of the plant and cause uncertainty when comparing the results from two installations.

The possibilities for local variation are so great that it is impossible to rely upon a comparison of the working results of two plants operating under different conditions as any criterion of the worth of the construction and design of the carbonizing installation itself. Even when the more prolonged actions occurring in a plant which can only be taken into account after months or even years of working are considered, the nature of the coal is still found to play a part. The damage occurring in the lower portion of vertical retorts which is generally ascribed to the action of the ash liberated from the coke by steaming is more pronounced with ashes of some composition than of others. The amount of scurf formed depends to some extent upon the coal. Low tar yield and high moisture content would not be expected to result in as much scurf as the reverse yields. The Institution of Gas Engineers' questionnaire revealed how great is the damage caused by the slagging of producer ash upon retorts. Again, the rate of attack must depend upon the composition of the ash—a circumstance which might explain the slight attack recorded at Beckton upon silica material at the same meeting by Mr. Edwards, in contradistinction to the general experience. The swelling of certain coals used in coke ovens but not generally in gas retorts sometimes causes such damage to the walls that quite new plants have failed and have had to be re-built after but a few weeks' working. The fact is that local variations in the conditions and in the coal carbonized may profoundly affect the behaviour of any carbonizing plant, and that at present there is no known way of eliminating the uncertain variables to which reference has been made.

Modern Legislation for the Gas Industry

By George Evetts, M.Inst.C.E., M.Cons.E.

No. 7

THE Author concludes his review summarizing the position of legislation up to the present time as it affects the Gas Industry to-day. Previous articles in this series appeared on Oct. 24 and 31, and Nov. 7, 14, 21, and 28.

Pipes for Ancillary Purposes and in Private Streets.

Gas Companies are empowered to lay pipes for ancillary purposes in the same way as they would pipes for the transmission of gas. Thus, if an Undertaking wishes to lay a tar or liquor or benzole pipe from its works through a street to a railway goods yard or an adjoining chemical works, it may do so, but in general the regulations governing the laying of such pipes are similar to those for laying pipes for gas.

With regard to private streets, Gas Undertakings can obtain power to lay pipes in streets not dedicated to public use. It is usual to find certain Clauses for the protection of railway companies, &c., where there are streets owned by such companies within the area of gas supply. They usually prescribe the method of laying in any such streets under the control of the railway company.

Clauses of Minor Importance.

There are many minor matters of a purely domestic nature dealt with by General and Special Acts; some are relatively unimportant, although of more than domestic application.

In general, there is machinery for the settlement of disputes. In certain fundamentals, it is assumed that the Undertaking must be the arbiter, and any dispute must be settled by recourse to the Courts. In other instances, where it is recognized that there is room for differences of opinion, there is machinery created for arbitration—for example, the relief from obligation to supply, or the imposition of a stand-by charge.

There are many clauses in Special Acts and Orders giving powers which shareholders or consumers might question the right of directors to exercise, such as:

Granting of pensions.
Taking licenses for use of patents and acquiring patent rights.
Appointment of Officers as Directors.
Appointing of Managing Director from among Directors.
Formation of Sick Fund.
Contribution to hospitals and charities, and educational institutions.
Purchase of sports grounds.
Purchase and equipment of showrooms, cottages, offices, &c.
Payment from Borough Funds to associations of municipal authorities or officers' associations, also for expenses of attendance at conferences and such like.
Notice to be given by consumers before quitting premises.
Charge for special reading of a meter at consumer's request.
Putting profit sharing schemes, &c., into force.
Remuneration of Secretary.

Some of these are in the "Model Bill," some are in Special Acts and Orders, and others are in the 1934 Act.

Profit-Sharing Schemes.

There are two types of profit sharing or co-partnership systems:

(1) Introduced under the powers of an enabling Clause.
(2) Introduced as a Parliamentary bargain between consumer, shareholder, and workman, *i.e.*, one to which the workman has a statutory right.

In some cases, schemes which are started under (1) become statutory under (2), and this might be the case with Undertakings changing over to basic price conditions. This is not essential, however, and there is at least one case where the existing co-partnership scheme has not been interfered with or even made compulsory under a Basic Price Order. In short, the provision of the workmen's share is not essential in basic price provisions, although it is desirable that there should be a scheme in operation equally good as to the benefits which might be obtainable out of such provision.

One further point in regard to the workmen. It is known that there is an agreement in existence between the Federation of Gas Employers and the Unions for dealing with the compensation of workmen thrown out of employment as the result of amalgamations. There is at least one order which schedules this agreement as part of the bargain between the Undertakings.

Consolidation by Order.

Section 15 of the 1934 Act extends the powers of the Board of Trade under Section 10 of the Act of 1920, and enables this body to make a Special Order consolidating the previous enactments of an Undertaking other than Public General Acts. This consolidation can be effected with or without such amendments as could be made under a Special Order.

Composite Companies.

Section 15 of the 1934 Act removes some doubt as to what can be done by the Board of Trade under Special Order in cases where Companies are combined gas and water, gas and electricity, or gas, water, and electricity. The Section provides that a Special Order under Section 10 of the 1920 Act can be made in respect of the three classes of Company above named—*i.e.*, the composite company is not debarred from obtaining any power obtainable under Section 10 of the Act of 1920.

There is a proviso to this Clause to the effect that the Ministry of Health is to be consulted in cases where the Company is authorized to supply water, and the Electricity Commissioners in cases where the Company is authorized to supply electricity.

It is to be noted that the supply of water and electricity respectively need not be involved in the application for powers, but it is the nature of the Company which is the ruling factor in regard to the consultation of the authorities mentioned. Further, the Clause does not specify to what extent the opinion or advice of the authorities concerned is to be given effect to in the order.

With regard to electricity, the Statutory Gas Companies (Electricity Supply Powers) Act of 1925 empowers Gas Undertakings to apply for orders under the Electric (Supply) Acts, 1882 to 1922. It also enables the Electricity Commissioners to empower such Companies to raise capital and apply their funds for electricity purposes authorized by Act or by any Order having the force of an Act. It is provided that the Commissioners should consult with the Board of Trade and impose such conditions as they see fit (including the keeping of separate accounts if they should so desire). The rules for the procedure under these applications were issued in 1927—Statutory Rules and Orders No. 19.

Another reference to Composite Companies is contained in the Gas Undertakings Act of 1929. Section 7 (*b*) enables the Board of Trade to authorize that loans raised by Composite Companies for the purposes of the gas portion may be secured by a charge upon the whole.

The Gas and Waterworks Facilities Act has received no mention so far in these articles, because the provisions are almost entirely superseded by the Gas Undertakings Acts. The Act, however, may still be of use to composite Gas and Water Undertakings, and an Order covering both sections of the Undertaking may be obtained in preference to obtaining a Gas Order under the Gas Undertakings Act and a separate Water Order under the 1870 Act. The rules referring to these applications for joint powers are Statutory Rules and Orders, 1926, No. 1,188.

Amalgamations by Special Order.

Although amalgamations can be cheaply and simply (not necessarily expeditiously) effected by Special Order, it is desirable to draw attention to a change recently introduced into Special Order procedure.

For many years it has been possible to amalgamate a limited liability company with a neighbour by a Clause in a Special Order providing for the immediate winding-up, thus avoiding the winding-up machinery necessitated by the Companies Acts. The Board of Trade have, it is understood, recently been advised that this is not strictly in accordance with their powers, and consequently orders in future will be dependent for their operation on the winding-up resolution being carried by the requisite majority and the appointment of the liquidator.

In the old form of Clause the Directors of the absorbed Undertaking were called upon to wind-up their Undertaking forthwith. The declaration of solvency delivered to the Registrar of Joint Stock Companies was the first step, and the absorbed Company was deemed to have passed a resolution for the winding-up of the Company on the date of the Special Order.

In the latest form it will be necessary, between the date of the order and the date of transfer, for a special meeting to be called and the necessary resolution for winding-up duly passed. The order cannot be operative until the machinery for winding-up has been put into operation by the vote of the shareholders and a liquidator appointed.

Special and General Acts, and Procedure.

The legislation dealt with is applicable to Great Britain. Although the legislation up to and including the Gas Regulation Act of 1920 applies to the United Kingdom, it must not be overlooked that the political condition of Ireland has changed, and the Gas Undertakings Acts of 1929, 1932, and 1934 would not apply to the Irish Free State, and they exclude Northern Ireland by direct reference.

Although the British Government has no further interest in gas matters relating to the Irish Free State, yet the legislation of the latter for all practical purposes embodies the Acts and Clauses to which reference has been made in these Articles. With regard to Northern Ireland, this still operates under English legislation, although applications for Acts or Orders are no longer made to the British Parliament or the Board of Trade.

In the case of new Acts in Northern Ireland, application is made to the Northern Ireland Parliament, and for Orders, to the Ministry of Commerce. The two Parliaments still work in conjunction, as for example in the case of the duties of Gas Referees. The Gas Referees at present do the work for the North of Ireland, and presumably an appropriate contribution is made towards the expenditure.

In general, the gas legislation in Great Britain is covered by the Gas Works Clauses Act of 1847, the Gas Works Clauses Act of 1871, the Gas Undertakings Acts of 1920, 1929, 1932, and 1934, together with the special Acts, and Orders having the force of an Act granted to individual Undertakings. Previous to the passing of the Gas Regulation Acts, the average Undertaking founded its legislation on the Model Bill, with appropriate modifications, and although there is a Model Bill still in existence, yet its provisions are very much out of date in certain important respects, and it is not of great value to-day. There are, of course, other Acts to which reference has been made, such as the Sale of Gas Acts, 1859 and 1860, the Metropolis Gas Acts, 1860 and 1861, Public Health Acts, 1875 and 1890, the Lands Clauses Act, 1845, &c., and the various "Companies" Acts regulating Public and Statutory Companies.

Prior to the passing of the Gas Regulation Act of 1920, Undertakings obtained either Acts of Parliament or Provisional Orders under the Gas and Waterworks Facilities Act of 1870; as far as gas is concerned this Act was superseded by the Act of 1920, and although the 1870 Act did not include the Metropolis, the amendment in the Act of 1920 gave the Board of Trade power to give Special Orders to Metropolitan Companies.

Bill or Order.

The majority of powers can be obtained through a Special Order, but there are certain things such as the compulsory acquisition of lands, the shutting up or diversion of roadways, and other matters which can only be dealt with by Act of Parliament. The time taken in getting an Act of Parliament through may be shorter or longer than a Special Order. It entirely depends on the time of the year chosen to apply for a Special Order and the amount of opposition entailed. On the question of cost, a Special Order is almost invariably cheaper than an Act. A Bill can be deposited in December of each year, and it is expected that the Royal Assent will be obtained in July or August of the following year. An Order can be applied for at any time of the year.

In promoting a Bill or Order, the services of a Parliamentary Agent are essential; the work is of a highly specialized nature and full of pitfalls for the layman.

Procedure with Bills.

With reference to Bills, the Standing Orders of both Houses of Parliament must be complied with. Notice of the Company's intention must be published in the *London Gazette* or the *Edinburgh Gazette* as the case may be, and in a local newspaper. The Notices must contain the salient features of the application, and any Local Authority or body of consumers or Statutory Undertaking, or even an individual affected, may lodge a petition against the Bill. If there is no opposition the Bill comes before the Unopposed Committee, and in this event the Agent and the responsible official of the Company must be prepared to answer any inquiries which may arise, and must attend the Committee to "prove the preamble"—*i.e.*, to verify the statements made in the introduction of the Bill which invariably sets out certain facts in respect of the Undertaking, and is, in short, a justification of the application to Parliament.

Before coming into Committee, however, the Bill is examined by the Lord Chairman and any unusual or undesirable departures from standard legislation are commented upon. These are known as the "Lord Chairman's remarks," and the departures from the normal legislation will not be allowed unless the promoters can show good reason for them. The Board of Trade or the Ministry of Health, or any other department concerned, are entitled to put in reports commenting upon the Bills. It is conceivable that if a Company promoted a Bill which was directly contrary to the policy of the Board of Trade, then that body would present an adverse report. It is then up to the promoters to satisfy a Committee of Parliament that the proposed powers are reasonable. In the event of the Bill being opposed, a Committee of Parliament is delegated to listen to the promoters and the opposition and give a decision. This Committee may be of the Lords or of the Commons, depending upon the House in which the Bill is introduced. In order to save time the Private Bills are divided between both Houses. If this first Committee throws the Bill out, the promoters can go no farther, but if it is passed with or without amendments the opponents still have an opportunity of appealing before the Committee of the second House to obtain further amendments or to get the Bill thrown out. It will be seen therefore that the public and all interested parties are protected at every turn, because the Royal Assent is not given until these various stages have been traversed.

Procedure with Special Orders.

With regard to depositing of Special Orders, the procedure is somewhat similar. The *Gazette* Notices have to be published and those in the local newspapers. All opponents are given a certain time to lodge objections and, in the event of objections being lodged, an inquiry is held where promoters and opponents can state their case. The Board of Trade either pass the Order, refuse it, or make what amendments they think desirable. The Order is then presented to Parliament. The House of Lords refers it to a Special Orders Committee. It is not considered for 14 days, during which opponents can deposit objections, thus putting the order virtually in the position of an application for a Bill, except that the hearing in this event is by a Lords Committee in the event of the Special Orders Committee deciding that further inquiry is desirable. The Order having been passed through the House without opposition, or being submitted to a Committee and passed, it is then confirmed by Parliament, and has the force of an Act.

In either case the promoters have to justify any extension of area they may propose, additional capital, differential charges, in fact any fresh proposal for the development of the Undertaking. Lands required for the purpose of the manufacture and storage of gas necessitate the serving of notices to owners and occupiers of dwelling houses within 300 yds. of the site, and any of these owners or occupiers can oppose the suggested utilization of the site.

It is not necessary for a Board of Directors to submit a Bill or Draft Order to their shareholders for sanction unless such Bill or Order embodies a change in the capital structure of the Company. In this event the Act or Order is submitted and the requisite majority is necessary before further progress can be made. If the Board of Trade think

fit they can ask for a special meeting and resolution, even though the Directors have not considered it necessary.

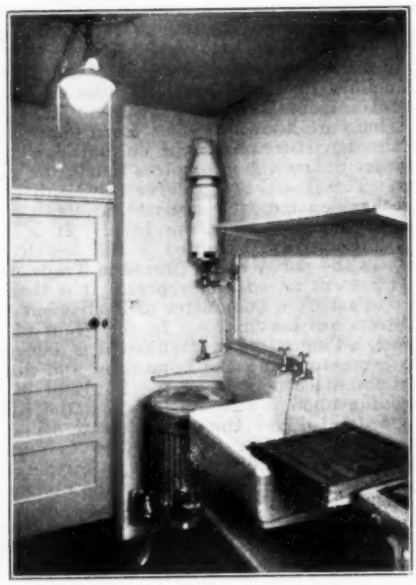
Conclusion.

If this Summary of Legislation at the present time appears in any way deficient and disjointed, the Author would plead the difficulty of setting forth the position in a series of short articles. This refers particularly to the miscellaneous Clauses.

It will be seen, however, that legislation in general is for the protection of the public. It will be found that, if any powers are given to the undertakers, corresponding protection is given to any person or body who might be affected thereby. It is not expected that a Public Utility Undertaking should have the measure of freedom possessed by an ordinary trading concern, though it must not be overlooked that the ordinary trading concern does not possess complete freedom. It has to create and issue its capital and run its business under the appropriate Companies Acts, and if it runs a factory it must conform to the Factory and Workshop Acts and general legislation. It has its problems of income-tax, rating, and labour, and, on the whole, it would appear that the Gas Industry has very little to grumble at since the passing of the 1934 Act, seeing that it is in possession of a partial monopoly.

Any amendment which can be offered is directed more to the machinery and delay in matters of detail than to a general criticism of the features of Gas Legislation as a whole.

[In response to various inquiries, we are pleased to announce that we shall shortly be able to publish Mr. Evetts' articles in book form at a price of 3s. 6d.]



Smokeless Flats for the Artisan

South Metropolitan Gas Company's Installation at Sassoon House, Peckham.

The photograph on the left shows a corner of the all-gas kitchen in one of the flats. The small multi-point water heater provides all the hot water requirements of the flat. The gas wash-boiler and lighting fitting are also shown.

It will be remembered that in our description of the South Metropolitan Gas Company's display at the Building Exhibition at Olympia last September we referred to a model on their stand (illustrated on p. 703 of the "JOURNAL" for Sept. 26) of a block of flats nearing completion at St. Mary's Road, Peckham.

These flats have now been finished; and we were enabled the other day, by the courtesy of the South Metropolitan Gas Company, to make a close inspection of a series of working-class dwellings—the rents of which vary from 9s. to 11s. per week, according to size—forming an admirable example of the way in which the Gas Industry can supply all the essential domestic services at a minimum cost to the artisan tenant.

Sassoon House, as it has been named, is typical of the modern trend of tenement building. It is constructed throughout of reinforced concrete and has five floors of four flats each, the two centre dwellings on each floor containing living-room, kitchen, bathroom, and two bedrooms, while the end two have an additional bedroom. The block has been erected by Mrs. Sassoon in memory of her son, and no effort has been spared in making the dwellings as comfortable as possible.

Each landing is suitably illuminated at night by means of special Sugg gas lamps, clock controlled for lighting and extinguishing at predetermined times from a master point below the stairs. In the case of fog or particularly dark days, the caretaker can turn on a master cock which lights up the lamps. The lights are operated on the pressure control system.

How Life is Made Easier.

Let us now enter one of the flats and see how life has been made brighter and easier for the working-class housewife by means of gas and solid smokeless fuel.

Immediately upon passing into the hall we have on our left the bathroom and lavatory. This room is, somewhat naturally, on the small side, and the bath is of the recently introduced type in which one sits rather than lies. Hot water is supplied from a small multi-point gas heater in the kitchen, which we will describe when we reach that room.

The lighting of the bathroom and hall is effected by chromium-plated bijou fittings. Also situated in the hall is a built-in cupboard intended for coke storage, above which is the penny-in-the-slot gas meter, well out of the way yet easily accessible. One of the bedrooms also opens out of the hall on the right.

Passing on we enter the living-room, which is the largest apartment in the flat, and from which opens a verandah by way of a glass-panelled door. The living-room is heated by a "Metro" coke stove, complete with gas ignition device, and this stove—as is the case with other of the fittings—is provided in four different coloured finishes in the different flats. The living-room lighting fittings, to which we also referred in our description of the Building Exhibition, have been specially designed for the somewhat low ceilings.

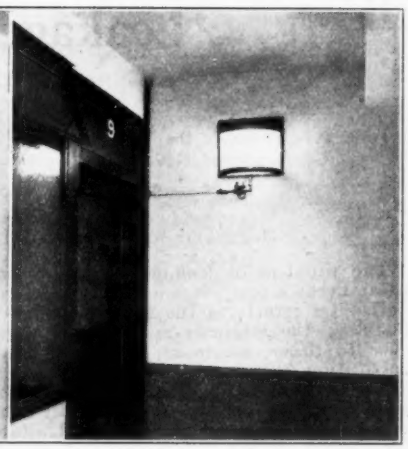
Special Lighting Fittings.

The bedrooms have no fireplaces, and a plug-in gas point has been provided in each bedroom, to which a portable gas heater may be attached, while to ensure ventilation suitable vents to the open air are fitted at almost ceiling level in each bedroom.

The bedroom lighting is effected by means of attractive chromium-plated bowl fittings dependent from hexagonal shaped ceiling plates. These fittings have been specially evolved for the purpose and are very pleasing in appearance. It was, indeed, mainly due to these fittings that

The living room, showing the " Metro " gas ignited coke fire and attractive lighting fitting.

The hall lighting fitting, which, like that shown in the living room, has a hexagonal white enamelled ceiling plate.



The Sugg's automatically controlled landing light, suitably protected from draughts.

gas was adopted for lighting in these flats; for it was admitted to us that electricity was originally decided upon as the illuminating medium throughout the building, and these pendents turned the scale in favour of the cheaper and more efficient method of lighting.

An All-Gas Kitchen.

From the living room one passes to the kitchen, which is a very compact little room, containing sufficient shelf and cupboard space and all-gas equipment. Here is situated the " Metro " multi-point gas water heater which has been specially designed by the Ascot Water Heater Company for the South Metropolitan Gas Company. This heater is automatic in operation, with safety gas cut-off device in the event of the gas meter running out. It is finished in white vitreous enamel, and supplies water at 105° F. instantaneously to the sink or bath, 16 gallons being provided for the latter in about a quarter of an hour at an expenditure of 17 c.ft. of gas, which is equivalent to 1d. at the prevailing rate.

The water heater is fixed in a corner of the kitchen immediately above the sink draining-board. Upon slipping this draining-board from its slot a gas wash-copper is revealed below, and an additional hot tap from the multi-point heater will enable the copper to be filled with hot water for laundry work, after which the copper's own gas ring will enable the clothes washing to be continued.

A Novel Cooker.

The gas cooker is of original design, and we are assured that, while small, it is adequate for the requirements of the household. The hotplate consists of two boiling rings—one of them of the duplex type—with a reversible griller between them. The oven is immediately below the hotplate and is heated by a single back burner. When it is desired to grill, however, the top plate of the oven may be withdrawn, thus enabling the grill burner to play directly down on to any food placed on the grid shelves inside the oven. This is an exceedingly space-saving cooker, measuring probably less than 18 in. in total height. The oven door opens outwards and downwards, and is self-balanced to close itself when released. There is also a plug-in cock in the kitchen, intended for the use of a gas iron, an extra large shelf at table level being suitable for ironing purposes.

The coke fire in the living room, the multi-point heater, and the wash-copper are all vented to the roof of the building by means of " Urastone " flue pipes.

We understand that the whole of this block of flats has already been let, and tenants will shortly be moving in; so that we may soon expect a further batch of satisfied tenants, who should become enthusiastic supporters of—gas. They cannot accurately be called " all-gas " flats because of the coke fires in the living rooms, and in this connection we inquired of the representative of the Gas Company what there is to prevent the uninitiated tenant, not realizing the merits of the coke fire, from trying to burn coal in the coke grates. We were assured, however, that the incoming tenants will be put in touch immediately with the local coke distributor, while it will be doubtless explained to them that gas coke is the proper fuel to use in their open grate.

Sassoon House is only one example of many similar blocks of " smokeless " flats which are springing up in many parts of the Metropolis. The South Metropolitan Gas Company are themselves responsible for the lighting, heating, cooking, and water heating installations in further blocks in Bermondsey, Brixton, and the Old Kent Road, among others.

Danish Gas Company.

Annual Report Indicates Continued Progress.

The Directors' report on the work of the Danish Gas Company for the year ended June 30, 1934, shows that the balance standing to the credit of profit and loss account, after charging pensions, administration expenses, &c., and transferring Kr. 231,426.44 to the redemption accounts, is Kr. 470,397.69. Out of this sum the Directors recommend that a dvidend of 6%, or Kr. 8.10 per share, be declared. This will leave Kr. 215,247.69 to be carried forward, an increase of Kr. 27,111.32 on the amount brought in.

A further capital expenditure of Kr. 335,950.80 for the extension of the carbonizing capacity mentioned in the last report, and for additional plant, mains, services, and meters, has been incurred during the year, and all necessary renewals and repairs have been carried out, and the works are in a condition to meet any demands upon them without any further capital expenditure for some time to come.

The quantity of gas sold during the past year has been 11,281,294 cub.m. (398,632,000 c.ft.), against 10,794,013 cub.m. (381,414,000 c.ft.) in the previous year, being an increase of 487,281 cub.m. (17,218,000 c.ft.), or 4·51%. During the year, the rate of exchange as between the Danish currency and Sterling has been maintained at about Kr. 22.40 = £1, and, as explained in the last report, this adversely affects the Company's revenue.

With deep regret the Directors record the loss sustained by the Company through the death, following a motor accident, of the Chairman, Lt.-Col. M. M. Bidder, D.S.O., M.Inst.C.E., who was for twenty-three years a Director of the Company. During the whole of this period he took the greatest interest in every detail connected with the Company, to which he rendered most valuable service. The Directors have also to report that Mr. Herbert G. Warren has, after more than fifty-two years' connection with the Company, retired, on a suitable pension, from his position as London Agent. The Directors would like to place on record their high appreciation of his valuable service over a long period. Mr. A. L. Janssens has been appointed to succeed Mr. Warren. At the meeting of the Board on Sept. 29, 1934, Mr. Henry Woodall, M.Inst.C.E., was elected Chairman, in the place of Col. Bidder, and Mr. Herbert G. Warren was chosen to fill the vacancy on the Board.

Leakage in Horizontal Gas Retorts

From a Paper before the Yorkshire Junior Gas Association, Nov. 17, 1934.

By A. H. CLUCAS, M.Sc., A.I.C., of the Leeds Corporation Gas Department

The problem of leakage became of special interest to us at Leeds a few years ago with reference to some of the horizontal retorts at the New Wortley Works. Mr. C. S. Shapley,[1] the Engineer and General Manager, made reference to these retorts in his Presidential Address to the Institution in 1930, and pointed out that many of the beds, after working 2,200 days, appeared to be in sufficiently good condition to work for a further 200 to 300 days provided careful control was exercised. It was realized that the extent of any leakage was an important factor, and further information was desired to enable these views on the economics of this relatively old plant to be modified or extended. A considerable amount of experimental work was carried out in co-operation with Mr. R. N. Webb, the Works Manager, the results of which are contained in condensed form in the Report prepared by the writer which was presented to the General Research Committee of the Institution in 1933. It is the purpose of this short paper to review briefly the contents of this Report. Although additional experimental work has been carried out, the results do not differ in general from those contained in the Report.

The Installation.

The straight coal gas from the retorts is mixed with producer gas at the foul main, giving an output exceeding 4 million c.ft. at 470 B.Th.U. gross per 24 hours.

The installation consists of 27 beds, each bed containing eight retorts and set in 3, 3, 2 formation. The retorts are made of fireclay, moulded in three lengths, 20 ft. 6 in. overall, and of a 22 in. by 16 in. oval ⌂ section. The main waste gas flues are situated at the top of the benches, and the waste gases are conducted there by uptake flues from the base of the regenerators. There is no waste-heat boiler attached to the settings.

Retort house governors are not employed. Anti-dips are used throughout, the ascension pipes are 6 in. in diameter, the cross-section of the hydraulic main is about 4 sq. ft., and the foul mains are 24 in. in diameter. These conditions materially assist in keeping the resistance to the flow of gases at a minimum.

The method of controlling the pressure conditions in the retorts has been developed by Mr. R. N. Webb,[2] and described by him to the Institution in 1931. The working conditions are controlled by endeavouring to maintain a pressure of + 0·02 to + 0·03 in. w.g. at the middle line of retort mouthpieces.

Estimation of Leakage by Analysis of the Waste Gases.

It is not possible to determine the exact composition of any crude coal gas leaking through the retort walls, and suitable assumptions have to be made. In any tests for leakage at least one bed of retorts was under review, and it is assumed that, when suitable intervals existed between the charging times, the crude coal gas from the bed as a whole approximated to a uniform composition during the survey. In the absence of evidence that excessive pressures within the retorts were a common occurrence, it was also assumed that the average composition of any crude coal gas leaking during a test was similar to that of the gas evolved from the bed.

It is estimated that any crude coal gas leaking through the retort walls (including tar, sulphuretted hydrogen, &c. —*i.e.*, all volatile products evolved from the coal) gave 13·2% carbon dioxide in its products of combustion (air-free, dry). It is, however, desirable to take into account only the thermal value of that portion of this leakage which, otherwise, would be recovered as purified coal gas and, by determination, this was found to be about 620 B.Th.U. (gross) per c.ft.

For the horizontal retorts under review, it can be taken as an approximation that every 0·1% depression of the carbon dioxide in the waste gases below that in the theoretical products of combustion is equivalent to 0·5 therm leakage per ton of coal carbonized. Actually, this equivalent increases slightly as the depression increases, and also it is influenced by various factors which have been incorporated in a formula given in the Report.

It will be apparent that the sampling and analysis of the gases must be done with extreme care, and the following remarks may be of interest in this respect. The composition of the producer gas and the carbon dioxide content of the waste gas may vary considerably for consecutive spot samples, and it is essential to take a sufficient number of spot samples, or else long period samples to average out these stress fluctuations. The apparatus described by S. Pexton and W. K. Hutchinson[3] and also F. J. Dent were found suitable. Spot samples were obtained with an apparatus that enabled them to be taken rapidly one after the other, or in duplicate, as required. The gases passed through a calcium chloride tube and then through bulbs arranged in parallel. A continuous gas stream was maintained throughout the apparatus, and the bulbs were sealed *in situ* before disconnecting. Condensation of water was encouraged from the waste gas and producer gas streams prior to entering the various sampling apparatus. Determinations of water vapour in the waste gases have shown the average amount to be 5 lbs. per 1,000 c.ft. If the whole of this should condense, the error in the carbon dioxide determination, due to solubility, would be about 0·002%—a negligible amount. At the same time, it was essential to avoid even a trace of water condensation in the gas sample bulbs. Such moisture, although having a negligible solubility effect, may react with the glass on standing, producing an alkali and causing serious absorption of carbon dioxide. This source of error was demonstrated by experiment, and was the cause of some of the earlier tests being cancelled, where such lowering of the carbon dioxide had been wrongly attributed to leakage.

Exact methods of analyses are essential, and a modified form of Haldane apparatus and also the Bone and Wheeler apparatus proved satisfactory. It is necessary to look for combustible gases in all waste gas samples. Small quantities of the order of 0·1 to 0·2% were indicated in many of the spot samples although there was an excess of 0·5 to 3% oxygen. This was probably present in the actual gases in the flues. In some tests where excessive coal gas leakage was made to occur the waste gas analysis indicated the presence of carbon monoxide, methane, and hydrogen in some quantity. The sulphur compounds in producer gas and waste gas should be removed from the gases before analysis, in order to eliminate errors which occur if any sulphuretted hydrogen in producer gas is reckoned as carbon dioxide.

Experimental Result—Normal Working Conditions.

The first desirable step in any investigation of leakage is to make measurements during the normal working of the complete plant, and tests were made on complete benches of retorts (consisting of six or more beds). Owing to practical difficulties peculiar to this plant, the results obtained were not considered to have an accuracy which justified more than a general indication that no very serious leakage of coal gas was taking place.

It was necessary to confine any one test to an individual bed of retorts, and the result of nine such tests, each representing a period of about ten hours, are given in Table I.

TABLE I.—*Coal Gas Leakage from Horizontal Retorts.*

[Normal Working Conditions.]

Test No.	Bed.	Working Life of Retorts. Carbonizing Days.	% CO_2 in Combustion Products (Air-Free).		Depression.	Equivalent Leakage per Ton of Coal Carbonized. Therms.
			Producer Gas. (*a*)	Waste Gases. (*c*)	(*a* − *c*)	
1	A	2,500	20·51	20·38	0·13	0·7
2	,,	2,500	20·52	20·30	0·22	1·2
3	,,	2,700	20·48	20·13	0·35	2·0
4	B	2,500	20·45	19·98	0·47	2·7
5	,,	2,650	20·58	20·37	0·21	1·1
6	C	1,900	20·57	20·23	0·34	1·9
7	,,	1,900	20·42	20·12	0·30	1·7
8	D	1,570	20·30	19·98	0·32	1·9
9	,,	1,620	20·47	20·07	0·40	2·3

The working lives of the retorts at the time of testing varied between 1,570 and 2,700 days for the different beds, and no retort had been scurfed within twenty days prior to testing. The pressures at the middle line of retort mouthpieces varied between + 0·02 and + 0·05 in. w.g. during each of the tests.

Leakage of coal gas was indicated in every case by this method of testing and varied between 0·7 and 2·7 therms per ton of coal carbonized.

Pressure Conditions within the Retorts.

It is, of course, well known that any leakage, either inwards or outwards, is a function of the differential pressure across the retort walls. The extent to which the recorded pressures at the retort mouthpieces are in agreement with the pressures on the inside retort walls is not known with certainty. In the case of vertical retorts pressures of 1 in. w.g. on the inside retort walls have been measured by H. B. Kendrick,[4] and K. C. Mead[5] has measured 3 to 4 in. w.g. in horizontal retorts even with slight vacuum conditions at the mouthpieces.

In the case of the retorts at New Wortley numerous experiments have been carried out in an attempt to measure the magnitude and duration of the pressures on different parts of the retort walls. At times some extraordinary pressures of the order of 15 in. w.g. were obtained during the early stages of carbonization. These high pressures were no doubt due to the resistance of the plastic layer, and in this connection it is interesting to note that G. E. Foxwell[6] has found that with highly caking coals pressures of many inches mercury are necessary to force gas through the plastic layer. In some of the surveys pressures of 1 in. w.g. were measured even after eight hours, although the ends of the pressure tubes were certainly within 1 in. of the retort walls, and, by this time, must have been in a zone where carbonization was completed. These results are not easy to interpret, and experimental difficulties make them inconclusive. Many of the surveys indicated that the pressures were quite normal and in close agreement with those recorded at the mouthpieces. The leakage results already quoted suggest that if any local regions of high pressure did develop, they were not of sufficient duration to influence seriously the extent of leakage. It is assumed therefore that, generally, the internal retort pressures were not greatly different from those recorded at the mouthpieces.

Records of pressures at the retort mouthpieces taken during complete carbonizing period have shown that the pressures at the top retort mouthpieces were about 0·02 in. greater, and those at the bottom retort mouthpieces about 0·02 in. less than those for the middle retorts, due to effects of specific gravity and altitude.

The design of the setting is such that pressure records on the flueside of the retorts are obtainable at two levels only—viz., (*a*) in the combustion chamber at the same level as the centre line of the bottom retorts, where it was found to average 0·01 in., and (*b*) at the top of the setting, 1 ft. above the centre line of the top retorts, where the pressure averaged + 0·04 to + 0·05 in.

The various pressure records indicate that, generally, the pressures at the retort mouthpieces (and assumed to be the pressures on the inner walls) were of the order of 0·01 to 0·02 in. w.g. greater than the pressures on the flue side of the retort at the same level.

Effect of Excessive Pressure Conditions within the Retorts.

In order to detect the effect of excessive pressure conditions, the leakage in one bed was determined under normal conditions, and again after the anti-dip pipes had been sealed at both sides of every retort; these latter conditions were maintained for a period of two hours, and gave a pressure of about 1 in. w.g. at the retort mouthpieces.

The average depression of the carbon dioxide content of the waste gases increased from 0·2% under normal conditions to 1·5% when the anti-dips were sealed, indicating that these excessive pressure conditions were responsible for serious loss of coal gas of the order of 15%. It should be noted that none of these retorts had been scurfed within twenty days prior to testing.

Effect of Newly Scurfed Retorts on Leakage.

The normal practice is to allow only one retort at a time in any one bed to be taken off for scurfing. In order to intensify any leakage effect it was arranged that four retorts in one bed were scurfed at the same time. Leakage determinations indicated a leakage of about 5% from the bed as a whole during the first few hours after charging the scurfed retorts, although the pressure conditions at the retort mouthpieces were normal. It is reasonable to assume that the major portion of this leakage was from the four scurfed retorts, so the leakage from these particular retorts was of the order of 10%.

Leaky Condition of Individual Retorts.

The various leakage measurements by the gas analysis method have demonstrated that careful pressure control and the scurf layer are both necessary to reduce leakage to small proportions.

It was still desirable to know the carbonizing time required to produce an effective coating of scurf. This information was obtained by using a method which consisted of pumping air into individual sealed hot retorts, and measuring the rate of delivery required to maintain some predetermined pressure. Such measurements give empirical values for the leaky condition of individual retorts. The method is simple and does not call for elaborate apparatus or precise gas volume measurements. Great accuracy is not claimed, but it is considered sufficient to enable similar retorts to be compared. In addition, measurements of the tightening effect of hot repair work, and also comparisons between cold retorts undergoing repairs, can be made. Numerous measurements have been made upon which the following conclusions are based. They are, however, confined to retorts that had given service for at least 1,500 days, as no retorts with less service were available at the time.

(*a*) The normal scurfing operation left the retorts in a very leaky condition, varying between forty and a hundredfold worse than that existing before scurfing.

(*b*) Surveys of complete "scurfing-to-scurfing" periods showed that, usually, after about three carbonizing days the leaky condition was only slightly worse than that existing before scurfing. After about six days the leaky condition did not alter to any great extent until the next scurfing operation.

(*c*) The normal hot patching work after scurfing seldom reduced the leaky condition by more than about 25%.

(*d*) The wet spraying of retorts, after scurfing, with a slip of refractory cement produced even less tightening than hot patching, and in some cases no tightening was observed.

(*e*) The first carbonizing period in a newly scurfed retort produced greater tightening than the combined effect of hot patching and wet spraying.

Influence of Scurf Formation.

It has been found that retorts tighten up quickly after scurfing, and the amount of scurf formed during that period must be very small. It is certainly not sufficient to form a layer which would completely cover the retort surface, and probably the greater part of it accumulates within the small cracks and interstices in the retort material. In order to speed up this tightening naphthalene is sometimes introduced into new retorts, and also after scurfing.

The demolition of old retorts has given ample visible evidence of the deposition of carbon within the small cracks and pores of the retort material. In a few retorts that had been scurfed before letting down, there was evidence that a greater portion of this carbon had been removed by these particular scurfing operations. In some cases, however, cracks and holes were observed of such dimensions that it is difficult to imagine any effective sealing by deposition of carbon within them. In such cases effective tightening was probably dependent on the formation of scurf layers over the openings.

The texture of scurf from different parts of a retort was found to vary considerably. That from the crown at the centre portion of the retort length often consisted of two distinct bands. The one adjacent to the retort surface, only about 0·15 in. thick, consisted of a number of very thin layers of silver grey carbon; the other portion had a remarkably open texture. It is apparent that any effective tightening by scurf of this type is confined to the band which consists of thin layers of laminated plates.

Difference of opinion exists as to the best method of scurfing. At Leeds it is customary to allow the scurf to accumulate for periods varying from 80 to 200 days and then scurf quite clean. The amount of scurf removed varies between 2·5 and 3 cwt. for a single retort. Another method referred to by K. C. Mead[5] is to burn off carbon accumulation at intervals of about 14 days for a period of 10-12 hours, and by this method it is claimed that, while the surface carbon is removed, it is probable the cracks in the retort material remain sealed up. Experiments carried out at Leeds with this short period method of scurfing have not shown, so far, that it possesses any advantages over the routine procedure.

In conclusion, although the time at our disposal has allowed only a brief survey of the many aspects of the problem, it is hoped that sufficient has been said to show that the extent of leakage from these old retorts was not a

serious factor. It was economically sound, therefore, to continue working them provided suitable working conditions were maintained, and so long as they were structurally strong enough to withstand the wear and tear of the stoking machinery.

This experimental work would not have been possible without the valuable help of Mr. F. Firth, the Chief Chemist, and the members of the Laboratory Staff, and also the unsparing co-operation of Mr. Webb.

The writer must thank Mr. Shapley for encouragement and advice given during the work, and for his permission to make use of the experimental data obtained for the interests of the Undertaking.

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[4] Kendrick, H. B. "The Control of Vertical Retorts." "GAS JOURNAL" (1930), 190, p. 306 *et seq.* "Experiments in Vertical Retorts." "GAS JOURNAL" (1930), 190, p. 484 *et seq.* Both in Proc. Assn. Gas Eng. and Managers, 1930.
[5] Mead, K. C. Contribution to discussion on "Leakage in Horizontal Retorts." A. H. Clucas, Institution of Gas Engineers, November, 1933.
[6] Foxwell, G. E. See "GAS JOURNAL," p. 82, Jan. 13, 1932.

Discussion.

The PRESIDENT (Mr. Ralph Halkett, Junr., Sheffield) said the Paper was the outcome of some splendid team work done at Leeds. The question of leakage in retorts concerned them all, whether of a large or small works, because leakage meant loss of gas and loss of money. Mr. Clucas had given an outline of a most valuable investigation and its results conveyed information and advice which they might all take with advantage to their own works to see if any alterations might be desirable on similar lines in combating this leakage trouble. If one had these flue gases leaking into the retorts one would have reduction of quality and variation in quantity, whilst if the opposite was happening in the way of outward leakage there would be a loss of gas make per ton of coal carbonized. The principle on which these losses had been corrected at Leeds seemed to have been excellent. The scurfing at intervals was a good idea as a regular system, because quite apart from the question of correcting leakage, they all liked to have the carbon from the retorts, for which there was quite a ready market. Mr. Halkett said he noticed Mr. Clucas made a rather strong point of sealing his retorts with carbon. The experience at Sheffield was also that spraying with a preparation, good as it might be in case of need, was not so good as the natural sealing.

Mr. B. THORPE (Huddersfield) said that, in regard to hot patching and spraying, at Huddersfield they had good results using a mixture of refractory material and 10% pitch. His experience suggested that a new bed of retorts tended to leak a good deal more than one which had been working for some time. In regard to scurfing, Mr. Thorpe said he would have thought an incomplete scurfing would have left a sufficient amount of material on the retorts. At Huddersfield they found it economical to scurf retorts a bed at a time. Roughly, it took four days before a bed was back in action in the case of fireclay, and about a week in the case of silica.

Mr. CLUCAS said he was much interested in Mr. Thorpe's observations. Finality certainly had not been reached in the matter of scurfing, but up to now in Leeds they had not found any more beneficial method.

Mr. F. FIRTH (Chief Chemist, Leeds) said they all owed a debt of gratitude to Mr. Clucas and his collaborators for this instructive paper. A point which was worthy of emphasis was that Mr. R. N. Webb, who had had much to do with this work in conjunction with Mr. Clucas, was rather a pioneer in the matter of advocating slight pressure conditions in the retort. Over-pulling may offer a temporary advantage but it could become a serious evil. Slight pressure in the retort was very necessary in order to produce the highest calorific value coal gas. Such gas, after dilution with blue water gas or producer gas to the declared calorific value, would then give the maximum thermal yield. For example, 100 therms of 500 B.Th.U. gas, when diluted with 290 B.Th.U. blue water gas, produced 106 therms of gas at 480. On the other hand, 106 therms of 480 B.Th.U. gas could be produced by diluting approximately 81 therms of 600 B.Th.U. gas with blue water gas. The significance of this, said Mr. Firth, was that when producing 600 B.Th.U. gas instead of 500 B.Th.U. gas, one could afford to have a leakage of more than 18% with the richer gas—an abnormal amount—and, after dilution with blue water gas, still produce the same number of therms per ton of coal carbonized.

Mr. HODGSON (Leeds) questioned the theory that coal gas leakage was constant throughout the retort.

Mr. CLUCAS said he presumed Mr. Hodgson referred to the composition of any coal gas leaking. This would, of course, vary throughout the carbonizing period. It had been assumed, however, that the average composition would be similar to the average composition of the make of gas during the period of a test, and which was actually determined. Provided no excessive pressures occurred within the retorts, it was considered that this assumption was reasonable.

Mr. HODGSON: What do you consider your chief successes as a result of this work?

Mr. CLUCAS: The retorts were considered old at 2,000 working days, but as a result of this investigation they are now considered not more than middle-aged. In fact, retorts are now in use that have worked over 3,000 days.

Mouthpiece Pressure.

Mr. V. J. J. SIDDONS (Barnsley): How near do you think you can assess the pressure within the retorts by finding the pressure at the mouthpiece?

Mr. CLUCAS: The pressure which matters is, of course, that on the retort wall. Many attempts were made to measure these pressures, but we are not satisfied that the results obtained did actually represent those on the retort wall, although many of them were in close agreement with those obtained at the mouthpieces. It is considered that if any local regions of high pressure did develop they were not of sufficient duration to cause serious loss by leakage. We feel that generally mouthpiece pressures are sufficiently indicative of internal pressures, although it is recognized that gas flow to the mouthpiece involves a slight pressure loss.

Mr. R. N. WEBB said the subject of the Paper was a very big one and he would like to say at the outset that the Paper was a most valuable contribution to the Transactions of the Association. [Hear, hear.] It had been his privilege to be closely associated with Mr. Clucas through the whole of the preparation of the Paper which, as they may know, was given as a Report to the Institution of Gas Engineers at the November Research Meeting in 1933. The work as put before the Institution was primarily due to Mr. Clucas himself, though of course the investigation itself involved a good deal of team work by everybody concerned in the working of the plant.

Mr. Clucas mentioned at the outset that successful carbonizing depended on many factors. One, the design of the plant, and by the courtesy of our Chief, Mr. Shapley, we have before us at this meeting to-day a complete drawing of the retort setting at New Wortley, accompanied by two sectional perspective views. The settings are of simple construction with a view to even distribution of heat and straight flows of gases throughout. Curtain-wall producers would be adopted if sufficient depth were available. The temperatures employed in the combustion chambers are from 1,385° to 1,410° C., and the temperatures of the waste gases at the bottom of the regenerators are from 580° to 610° C. The average coal carbonized per retort per 24 hours is now 26·75 cwt. All the foul gas mains are of ample proportions.

Many questions had been asked, said Mr. Webb, which were more particularly concerned with the practical working benefits gained from the investigations than perhaps in respect of the Paper itself. This was natural and expected, and that was why Mr. Clucas had invited his collaborator to augment his own replies. All interested in the problem of retort leakage should make a study of the Report made by Mr. Clucas twelve months ago, because it was equally valuable whatever may be their own type of carbonizing system. It was pretty well known, of course, that at New Wortley they had been experimenting for some years on controlled pressure conditions in carbonization. The two subjects, therefore, dovetailed into each other and enabled fairly definite conclusions to be drawn. In regard to the mention of slight pressure and working at level gauge, this had been attempted at first at New Wortley, but owing to varying results in calorific value, &c., it was later decided to work at a minimum pressure. The conditions of which he was speaking, of course, were at the retort mouthpiece. Their practice was to keep as nearly as possible two to three hundredths pressure at the middle row of retorts and to avoid going below zero. When such conditions were maintained, the calorific value of the straight purified coal gas averaged 620 B.Th.U.; if the pressure conditions fell to one to two hundredths below zero the calorific value of the gas was reduced to 550 or 560 B.Th.U. and would doubtless fall further if such conditions were maintained.

Scurfing and Spraying.

In regard to scurfing, Mr. Webb said the practice at New Wortley was to allow scurf to accumulate until it could very readily be removed. The period varied a little but averaged about three months. The time occupied in scurfing a retort, from taking off to charging again, was four to five hours with new retorts and sixteen to eighteen with old. They did not have more than one retort per bed off for scurfing at a time at New Wortley. The retorts were sprayed with a "slip" of refractory cement after each scurfing. While not tightening the retorts at all, this much facilitated the discharging of the coke in the older retorts. In consequence of the improvement in design and construction of the settings they found hot patching unnecessary; they believed it was a thing of the past. The joints of the retort settings were filled in again after scurfing, and this was practically all that was required.

In support of Mr. Clucas' reply to Mr. Hodgson's question as to what were considered the main benefits from the investigations, Mr. Webb said they were substantial and, as had been mentioned by Mr. Shapley on more than one occasion, were seen in the Gas Department's balance-sheet. The work had proved that retorts were not tight until they were slightly coated with scurf. It showed that this coating must be maintained—hence the need to work at slight pressure. By maintaining this coating the richest gas was secured, thus enabling the maximum

quantity of diluting gas, whatever the type, to be mixed with it. Whilst such tightness was maintained it could be assumed that the retorts were in good order and, providing conditions were sound in the internal part of the settings, there was no doubt as to their continuing the work. At New Wortley to-day they were working six beds of retorts that had been making gas for 3,200 days and were looking forward to the new beds working even longer. From what had been learned, his own opinion was that retorts could easily be built to last 4,000 working days—the economic value of which would readily be recognized, especially by those who built their own. The retorts at New Wortley were of fireclay, not silica.

Vote of Thanks.

Mr. B. THORPE (Huddersfield), moving a vote of thanks to Mr. Clucas for his paper, coupled it with an expression of appreciation of the work of Mr. Webb and all who had collaborated. The Yorkshire Junior Association also, added Mr. Thorpe, were glad to congratulate Mr. Clucas on having been awarded the M.Sc. of Leeds University in recognition of the investigation and also for the Report presented to the Institution of Gas Engineers.

Mr. H. THACKERAY (Elland) seconded the motion.

Mr. CLUCAS, in reply, said this matter was not the achievement of one individual but the work of a happy team, and he expressed his own thanks to Mr. Shapley and the Leeds Gas Committee for facilities afforded in preparation of the paper.

On the proposition of Mr. J. B. BALMFORTH (Bingley), seconded by Mr. J. W. CARLTON (Shipley), Mr. Shapley and the Gas Committee were warmly thanked for the facilities offered for that day's Meeting at Meadow Lane Works and for the hospitality provided.

Mr. SHAPLEY, in a brief response, said it was always a pleasure to have the Yorkshire Juniors visit Leeds. He congratulated Mr. Webb on having lately had the honour of being elected a Vice-President of the Manchester Senior Association.

Mr. N. G. APPLEYARD, Works Manager at Meadow Lane, after expressing a brief welcome to the members of the Association on behalf of himself and his staff, gave an outline of the nature and working of the Benzole Recovery Plant installed at that works about 8 months ago, by Messrs. W. C. Holmes & Co., Huddersfield. The plant is capable of dealing with seven million c.ft. of gas per day. The benzole produced during the eight months' working was equivalent to an additional sale of gas exceeding 54 million c.ft.

The members were subsequently conducted over the benzole plant by Mr. Appleyard and members of his staff.

Southern Association of Gas Engineers and Managers

Autumn General Meeting at the Hotel Metropole, London, Nov. 30, 1934.

The Autumn General Meeting of the Southern Association of Gas Engineers and Managers was held at the Hotel Metropole, London, on Friday, Nov. 30, 1934—the PRESIDENT (Mr. Stephen Lacey, of the Gas Light and Coke Company) in the Chair.

The Minutes of the last meeting, as published in the "GAS JOURNAL," were taken as read.

Election of New President.

The PRESIDENT, in opening the proceedings, remarked how glad he was to see so many members present who had come up from the West. He went on to propose the election of Mr. E. L. Nicholas, of Guildford, as their President for the year 1935. Last year they had elected Mr. Nicholas as Vice-President with the intention that, all being well, he should take up the office of President in due course. Mr. Nicholas was now prepared to serve, so that he had the greatest pleasure in proposing his election. They could not have a more suitable candidate for President, for he had had a wide experience. He had commenced his career at Exeter, whence he had gone to Cardiff and subsequently to Blackburn, while for the past eleven years he had been Engineer and Manager at Guildford. Having been in both Exeter and Guildford he was able to represent both Eastern and Western Districts.

Mr. W. N. WESTLAKE (Exeter) seconded the resolution, which was carried unanimously.

Mr. NICHOLAS, in returning thanks for his election, said he would endeavour to serve them to the best of his ability. He hoped they would shortly receive an invitation to visit Guildford, and if they did not find the gas-works there as interesting and instructive as many, he hoped that the amenities of Guildford would make up for this in another way. It was possible, he said, that having had Presidents from the East for two years in succession, there might be members from the West who might think that they had been overlooked. He assured them, however, that he was a Westerner by birth, and he hoped to visit the Western District during the coming year. Once again he thanked them very much for his election.

Election of Vice-President.

Mr. NICHOLAS then proposed the election of Mr. R. J. H. Clark, of Plymouth, as Vice-President of the Association for the year 1935. Mr. Clark, he observed, had been a very keen member of the Association for many years. He had succeeded Mr. P. S. Hoyte, a Past-President of the Association, and many would remember the most enjoyable day they spent at Plymouth about ten years ago. Mr. Clark would also be remembered by reason of the paper he read last year on "Considerations of a Coal Handling Problem." He felt sure Mr. Clark would fill the position with credit to himself and distinction to the Association.

Mr. F. BLACKBURN (Devonport) seconded the resolution, remarking that, as Mr. Clark's nearest neighbour, he could fully endorse all that had been said in regard to his election.

Mr. CLARK asked the members to accept his very best thanks for the honour they had conferred upon him in electing him Vice-President. He appreciated it very much indeed—particularly as he had only been associated with the Association during the past six years.

District Committees.

The HON. SECRETARY (Mr. J. H. Donaldson, of Sevenoaks) announced the following personnel of the Eastern and Western District Committees:

Eastern District.

Chairman.—Mr. S. E. Whitehead.

Vice-Chairman.—Mr. D. F. Irving.

Committee.—Messrs. E. F. Smallbone, S. E. Whitehead, C. V. Bennett, W. H. Bennett, C. F. Botley, G. R. Bullwinkle, T. Carmichael, J. H. Donaldson, H. Gage, *R. J. H. Clark, W. Grogono, J. F. Haseldine, L. G. Humphrys, D. F. Irving, S. Lacey, L. J. Langford, *E. L. Nicholas, F. J. Robinson, R. H. Ruthven, W. J. Sandeman, H. C. Smith, A. W. Sumner, L. Trewby, *W. A. Howie, D. C. Cross, W. H. Warren, and J. H. Hornby.

* Members *ex-officio* (Rule 9).

Hon. Secretary—Mr. W. A. Howie.

Representatives on the General Association.—Messrs. W. Grogono, E. F. Smallbone, and J. F. Haseldine.

Representatives on the District Education Committee of the Institution of Gas Engineers.—Messrs. D. C. Cross, H. Gage, G. R. Bullwinkle, and S. E. Whitehead.

Western District.

Chairman.—Mr. J. B. Cattle.

Vice-Chairman.—Mr. J. H. Lowther.

Committee.—Messrs. F. Blackburn, *R. J. H. Clark, J. H. Cornish, W. E. Dean, R. S. Falkner, S. E. Halliwell, *W. A. Howie, C. Harris, P. S. Hoyte, H. Higham, S. J. Ingram, *E. L. Nicholas, J. H. Pye, E. Samuel, C. Stapleton, J. Taylor, R. C. Taylor, A. Thomas, H. W. Versey, and W. N. Westlake.

* Members *ex-officio* (Rule 9).

Hon. Secretary.—Mr. J. H. Cornish, Junr.

Representative on the General Association.—Mr. F. Blackburn.

Representatives on the District Education Committee of the Institution of Gas Engineers.—Messrs. J. B. Cattle, R. Robertson, C. Harris, and W. N. Westlake.

The Hon. Auditors of the Association (Messrs. James Donaldson, Southborough, and John Urquhart, Dorking) were unanimously re-elected on the proposition of Mr. L. J. LANGFORD (Tunbridge Wells), seconded by Mr. C. F.

BOTLEY (Hastings), and Mr. URQUHART briefly returned thanks for his re-election.

A New Hon. Secretary.

The PRESIDENT intimated that Mr. J. H. Donaldson was, to their great regret, retiring from the position of Hon. Secretary of the Association after five years' service in that capacity. It was the Hon. Secretary, he remarked, who carried the Association along, and he paid tribute to Mr. Donaldson's work for them. But they could not expect Mr. Donaldson to remain Hon. Secretary for ever, and they were very glad to have Mr. W. A. Howie, of Gravesend, to succeed him. Mr. Howie had already done a great deal for the Association, having been for some time Hon. Secretary of their Eastern District. He had much pleasure in proposing Mr. Howie's election.

Mr. H. C. SMITH (Tottenham) seconded this resolution, remarking that they were going to have a man who would make an excellent Hon. Secretary of the Association.

The resolution was carried unanimously, and, in acknowledgment, Mr. HOWIE said that it was with great appreciation that he rose to thank them for the very nice sentiments they had expressed. He realized that the Association had been extremely well served in the past by their Hon. Secretaries, and he assured them he would play his part in an endeavour to carry on the success of the Association.

New Members.

The following applicants for membership of the Association were unaimously elected: Messrs. W. Bell (Reading), J. H. Carrington (Brighton), R. Gray (Wandsworth), K. L. Mortimer (Hornsey).

Mr. W. E. Price Elected an Hon. Member.

Mr. C. VALON BENNETT (Rochester), President of the Institution of Gas Engineers, moved that Mr. W. E. Price be elected to Hon. Membership of the Association. He considered it a very great honour, he said, to be asked to move this resolution. The list of Hon. Members of the Southern Association was a very select one, and was reserved for gentlemen who had done great work for the Association and for the Industry. Mr. Price was elected to membership of this Association as long ago as 1879. The Association was formed in the year 1875, so that he was elected a member only four years after they came into being. He had therefore been a member for fifty-five years —which was a marvellous record. He was President of the Association in 1902, while he believed that he had also occupied the position of Hon. Secretary for a period of five years. They of the Institution of Gas Engineers, of which most of those present that day were members, would appreciate that the Southern Association had given up a very valuable officer when Mr. Price was elected Hon. Secretary of the Institution. Mr. Valon Bennett remembered that day very well; he recalled the sorrow they felt at losing his services as Hon. Secretary of the Association. He had experienced, before occupying the chair of the Institution, the wonderful work which Mr. Price had done as Hon. Secretary of the Parent Body. He had a good training in this Association, and the Institution were grateful to them for having released him. They congratulated him upon being the oldest member of the Association, and they wished him many years of life and health.

Mr. JOHN TERRACE (London) said that it was with peculiar pleasure that he seconded this resolution, because it was 32 years ago, when Mr. Price was President of the Southern Association, that he joined the Industry and became a member of the Association. Mr. Price, he said, was well known throughout the length and breadth of the land, and they were proud to know that, as the President of the Institution had suggested, he had carried out his first duties in the Southern Association, and they all felt very grateful to that Association for allowing him to go over to the service of the Institution. But they were principally concerned that afternoon with Mr. Price's work for the Southern Association, and they all felt that if anyone deserved this honour of being made an Hon. Member of the Association it was Mr. Price, and he had the greatest pleasure in seconding the resolution.

Mr. W. E. PRICE (Hampton Court), in acknowledging his election to Hon. Membership said that fifty-five years ago he joined this Association; but there was something further than that; his father was one of the six originators of the Association in 1875, when half a dozen engineers met together at the Richmond Gas-Works to form their Association, with Mr. J. C. Chapman, of Harrow, as the Hon. Secretary. As time went on he was honoured by being elected as their President, while for a few years he was also Hon. Secretary; and he gained much pleasure and experience during those days, when, after the formal business of their meetings, they used to get together for a chat and an exchange of experiences whereby their respective undertakings, he was sure, benefited considerably. It was not only what they heard at meetings which helped them, but what they heard also unofficially in the course of their membership of such Associations. He felt it a great honour to be elected one of these select few.

Alteration of Rule.

The PRESIDENT then proposed a resolution to amend the rule relating to the subscriptions paid by members of the Association, as follows:

> All engineers and managers, assistant engineers and managers, and all those actively engaged in the Industry, £1 1s.
>
> Retired engineers and managers and assistants, and engineers and assistants abroad, and Associates, 10s. 6d.

Commenting upon this proposed alteration, the PRESIDENT said that in 1927 changes were made in the rules which made eligible for membership heads of technical departments of gas undertakings, and up to that time membership of the Association had been confined to engineers and managers proper.

The resolution was seconded by Mr. NICHOLAS and unanimously agreed to.

Presentation of Certificates.

The PRESIDENT then presented certificates to successful candidates in the Gas Engineering and Gas Supply Examinations of the Institution of Gas Engineers. The full list of successful candidates is as follows:

EXTERNAL HIGHER GRADE GAS ENGINEERING.

First Class	H. J. Patching	Deal
Second Class	C. T. Bichard	Guernsey
,, ,,	H. A. Cole	Yeovil
,, ,,	G. W. Curtis	Birchington-on-Sea
,, ,,	D. L. Rumble	Reading

INTERNAL HIGHER GRADE GAS ENGINEERING.

First Class	J. S. Fox-Andrews	Bath
,, ,,	R. W. Latham	Sutton
,, ,,	J. Malsbury	London, W. 2
,, ,,	G. F. J. Murray*	Plymouth
,, ,,	C. W. Nash	Norbury
,, ,,	C. G. Reeve	Hornsey
,, ,,	W. H. White	Streatham
Second Class	A. Goodale	Wandsworth
,, ,,	A. A. Hall	Chelsea
,, ,,	G. G. Holmes	North Stifford
,, ,,	J. V. Knight	London, S.W. 1
,, ,,	R. Miller	Crayford
,, ,,	K. C. Rees	Wandsworth Common
,, ,,	J. B. Thorndycraft	Rosherville
,, ,,	G. O. Turner	Croydon
,, ,,	T. C. Tweddell	Greenford
,, ,,	G. Yorke-Davies	London, W. 1

* With Distinction.

EXTERNAL HIGHER GRADE GAS SUPPLY.

First Class	B. G. H. J. Hawkings	Plymouth
Second Class	H. A. J. Gunning	Brislington
,, ,,	J. E. Wilkes	Sunninghill

INTERNAL HIGHER GRADE GAS SUPPLY.

First Class	L. A. Cardy*	Streatham Hill
,, ,,	F. S. Eames	Rotherhithe
,, ,,	S. W. Hayes	New Malden
,, ,,	J. E. Law	London, S.E. 15
,, ,,	R. M. Munns	Chelsea
,, ,,	D. H. Rouse	Brixton
,, ,,	S. A. Smith	Battersea
,, ,,	A. R. Tarrant	East Croydon
,, ,,	P. G. Wright	Shortlands
Second Class	H. W. Avis	Redhill
,, ,,	E. A. Coltman	Tottenham
,, ,,	F. C. Dines	Deptford
,, ,,	W. H. Edmonds	Forest Gate
,, ,,	G. W. Evetts	Streatham
,, ,,	H. M. Hentschel	London, N.W. 10
,, ,,	D. R. Nicol	London, S.E. 23
,, ,,	J. E. Ross	London, N. 12
,, ,,	A. P. Scarth	Coulsdon
,, ,,	J. W. G. Tatam	Croydon
,, ,,	W. G. Wigley	London, E. 1
,, ,,	H. T. Wright	Battersea

* With Distinction.

A paper was then presented by Mr. W. Dieterichs, of the Gas Light and Coke Company, on "The Work of an Industrial Centre"—see other pages of this week's issue.

The meeting concluded with a hearty vote of thanks to Mr. Lacey for his Presidency of the Association, on the proposition of Mr. D. H. HELPS (Reading), who remarked that he could look back on a long line of distinguished Presidents—men who were engaged as engineers in the production of gas. During the past year they had been extraordinarily fortunate in having as their President Mr. Lacey with his wide experience of the sale and distribution of gas.

The vote was seconded by Mr. J. W. WHIMSTER (Bath) and heartily accorded; and Mr. LACEY briefly returned thanks.

The Work of an Industrial Centre

A Paper read before the Southern Association of Gas Engineers and Managers at the Autumn General Meeting in London on Nov. 30, 1934.

By W. DIETERICHS, Assoc.M.Inst.Gas E., of the Gas Light and Coke Company

There has never been a time in the history of the Gas Industry when competition between the various fuels has been so keen as it is at the present day, and it is obvious that if we wish to make the most of the opportunities which offer themselves we must enlarge our activities and develop our organization to meet the new conditions. We all realize the many advantages that town's gas has to offer, but at the same time we must not forget that our competitors are making great progress in the technique of fuel application; and some of the advantages over competing fuels which could be offered by town gas a few years ago, and which enabled a higher premium to be charged, have lost a little of their value. Among the developments which one may mention are the improved oil burners, which may be fully automatic and may have accurate thermostatic control, the various forms of electric heating schemes, automatic control of electric furnaces, and improved mechanical stokers for solid fuels. There is, moreover, a marked tendency for the effective price of competing fuels to fall, either by reduction in selling price or, as in the case of oil, by the application of cruder and cheaper qualities. It is well to bear in mind, especially when industrial loads are considered, that the Gas Industry is always in competition with fuels whose intrinsic price is far below that of our own. The present position is illustrated by the following table giving the approximate costs of a number of alternative fuels in the south of England:

Fuel.	Calorific Value.	Price.	Price per Therm.
Coal	14,500 B.Th.U. per lb.	25s. per ton	0·9d.
Coke	12,750 ,, ,,	34s. ,,	1·4d.
Oil	18,500 ,, ,,	75s. ,,	2·2d.
Producer gas . .	150 ,, per c.ft.	3d. per 1,000 c.ft.	2d.*

* Excluding capital charges and depreciation.

I mention these facts not in any pessimistic vein, but simply to show that the time has come when it is essential to have the most complete co-operation between the gas undertakings throughout the country and all suppliers of gas-fired equipment. Our chief competitors, the oil interests and the electrical industry, are already organized on such a national basis. In the recently formed Industrial Centres we are trying to build up an organization which will make the desired co-operation real and effective.

Position Before the Centre Scheme.

Let us review the industrial position in this country before the Regional Centre Scheme came into being. It was already realized that it was no longer sufficient for the Gas Industry to supply fuel to its consumers with an attitude implying "Take it or leave it," but that it was also necessary, in conjunction with the suppliers of equipment, to design and produce plant guaranteed to do the job, and to demonstrate its use to the consumer.

There were, however, only six or seven undertakings at the most which had sufficient resources to tackle this work adequately from the technical and commercial points of view, for the smaller undertakings necessarily lacked the trained personnel, the equipment, and the experience which will always be required to deal with the variety and the complexities of industrial gas application. The six or seven undertakings in question have undoubtedly done a tremendous amount of spade work which has helped to further the use of gas for industrial purposes, but this work was only partially co-ordinated and was not generally available for the Industry as a whole. The other undertakings, either smaller or less well organized, applied for information on industrial subjects to one of the national bodies, who in turn passed the inquiry to those undertakings whom they considered best capable of assisting. There is no doubt that this system imposed a serious burden on the undertakings which were called upon to assist, and if it had been allowed to continue would have been detrimental to their organization. Not only this, but many undertakings were reluctant to seek information in this way, knowing perfectly well what cost would be involved, and they were not prepared to accept this kind of service without some form of payment.

The Purpose of the Scheme.

The Centre Scheme was designed to organize the interchange and distribution of information on a sound contributory basis and make available all existing knowledge and experience, and also to co-ordinate policy. In addition, it is intended to enable the smaller undertakings to use the Centres in an advisory capacity to assist in dealing with any problems which may arise. This assistance is often desirable, because, unlike domestic appliances, industrial and commercial plant is rarely standardized and most problems require the personal attention of an experienced man.

To illustrate this I want to take the case of a very common industrial process—namely, the hardening of high-speed steel, and to indicate the various difficulties which may have to be overcome in handling a job of this nature.

In the first place, to obtain the order it is often necessary to give accurate estimates of fuel consumption and to guarantee that the furnace which is being recommended will be capable of turning out a given quantity of the product of the required quality. In making his recommendation, therefore, the salesman must not only discriminate between the various makes of furnace which are available for the process, but also choose a size suitable for the output required. He must also bear in mind that if the furnace he chooses is too expensive or if the gas consumption specified is too high, he may lose the job to a competing fuel. At this stage, therefore, accurate information is essential.

Supposing the order to be obtained, it will become necessary to fix the furnace in conjunction with its fan and motor, burner controls, non-return valve on the gas supply, &c., to adjust it to the optimum working conditions, and to demonstrate its use to the consumer. Here again some experience is essential. The process I have chosen is a standard one which is frequently met with, and the difficulties of the procedure are, of course, greatly increased in any special process which requires to be treated along novel lines.

There are many undertakings, particularly in the south of England, which consider their districts to be 99% residential and which are inclined to be sceptical as to the value to them of the Centre Scheme; but even in cases where there may, perhaps, be no industrial load in the accepted sense of the term, there are always innumerable commercial applications for gas to which the same conditions apply. There are few districts, for instance, where there are not possibilities of heating loads of a specialized character in dairies, bakeries, dry cleaning shops, butchers' shops, restaurants, fish-frying establishments, &c., and there are also numerous possibilities in the form of central heating, swimming baths, open-air baths, Turkish baths, and so on.

It must be realized that whenever a potential gas load is held or obtained by a competing fuel, either on account of the inefficiency of the available gas appliances or because of the excessive cost of gas, the information very quickly spreads throughout the country and is used by our competitors to sell their own fuels. For example, take the case of a large firm having branch works throughout the country. If the equipment at any branch is allowed to fall into an inefficient state it is obviously a target for our competitors, and if the load is lost a reaction will be felt at every other branch to the disadvantage of the undertakings concerned. As an extreme example I could tell you of a case where a London firm has recently installed expensive electric furnaces for the sole reason that its parent company in the United States had been persuaded to do the same. It is therefore important for all undertakings, whether their districts be regarded as residential or industrial, to make certain that no stone is left unturned

to ensure that the most modern equipment is put forward for every process.

Origin and Present Position of the Centres.

It was thought at first that one Central Information Bureau would be the most satisfactory way of dealing with the problem, but it was later agreed that over-centralization should be avoided, and a manageable number of district Centres were therefore set up to cover the whole country. The Centres are not so numerous that their activities are difficult to co-ordinate, but they are sufficient to cover the whole country adequately. It is an obvious advantage of the de-centralized scheme that it enables personal contact to be maintained between a Centre and its member undertakings in a way that would otherwise have been impossible, and it also enables each Centre to specialize in the type of problem most important in its sphere of action.

The general position at the present time is that eight of the ten Centres which have been formed have now been formally constituted, while two are provisionally working in with the scheme. The following list shows the memberships of each Centre:

Centre.	No. of Members (including Undertaking running the Centre).
(*a*) Gas Light and Coke	74
(*b*) South Metropolitan	9
(*c*) Birmingham	32
(*d*) Newcastle	11
(*e*) Cardiff	17
(*f*) Manchester	18
(*g*) Yorkshire	47
(*h*) Liverpool	19
(*i*) Bristol	(Provisional)
(*j*) Scottish	"

A central Information Bureau with a whole-time staff has been set up at Grosvenor Gardens under the ægis of the British Commercial Gas Association, and the function of this Bureau is to collect, file, and duplicate information so that it is available for the Centres when required; also to carry out the necessary staff work of the scheme, and prepare reports on any subject connected with it. Installation sheets describing representative installations are provided by the various Centres and forwarded to the Information Bureau, who duplicate them and forward them to all Centres. In a very short time a considerable amount of information originating in every part of the country will be available not only at the Central Information Bureau, but also at all Centres.

The Functions of a Centre.

The direct benefits of the Development Centres can be seen from the following services which each Centre is prepared to offer to its members:

(*a*) To set up and maintain an industrial centre and demonstration room displaying typical industrial gas apparatus.

(*b*) On request to supply by correspondence, information relating to industrial gas problems.

(*c*) To provide an efficient technical staff. This staff will be at the service of the contributing undertakings—(i.) to interview by appointment at the development centre representatives of the contributing undertakings and their clients, and supply information with regard to, and demonstrate, the merits of gas for particular purposes; and (ii.) to visit by appointment premises in the area of the contributing undertakings and advise upon the merits of gas as against other fuels.

(*d*) To collect and tabulate data and comparative statistics in respect of various heat processes, and to compile the results of tests and experimental work carried out at the development centre, and periodically to forward the same to contributing undertakings, together with a detailed statement of any particular problems examined and orders obtained for industrial and commercial gas.

(*e*) To prepare and tabulate for the confidential use of contributing undertakings, lists of prices at which gas is found to be competitive in each district or part thereof with other fuels utilized for industrial and commercial purposes.

(*f*) To assist in the training of industrial experts sent to the centre by subscribing undertakings.

I have often discussed the question of Industrial Showrooms with those responsible for the smaller undertakings, and there is no doubt that they would not be an economic proposition. First, the apparatus is usually heavy and bulky, and if many typical examples are to be displayed, the Showroom will have to be somewhat large; secondly, it requires a man with a considerable amount of experience to discuss the varied inquiries which are received, and to demonstrate in a practical way the various processes for which gas can be used satisfactorily. There is no need to enlarge on Clause (*b*), but from the number of inquiries which have been received by the G.L.C. Centre from various subscribing undertakings, this must have proved very useful. Within the last few weeks, information has been given on the heat-treatment of steel, bread baking, salt baths, Turkish baths, factory heating, oxy-coal gas cutting, organ blowers, fish-frying, sterilizing, firing of ceramics, and numerous other processes. In connection with Clause (*c*) I would like to mention that quite a number of inquiries can best be handled by the recognized suppliers of equipment. In such cases, of course, the Centre can perform a useful function in recommending the firm of manufacturers most suitable for the particular inquiry and in checking the specifications and estimates which are given. Altogether a large number of inquiries have been handled. In some cases important new loads have been obtained—*e.g.*, for bread baking, Turkish baths, &c.—and in other cases existing appliances have been modernized to avert displacement by other fuels, while in other instances negotiations are in progress for large new installations.

These new installations represent the direct benefits of the new scheme, but in addition there are indirect benefits which may ultimately be of even greater value. For instance, the existence on a company's area of supply of large industrial or commercial loads, whether newly installed or recently modernized, has a prestige value which is bound to react favourably on the general appreciation of gas as a fuel and ultimately on the domestic load. The member companies will also benefit from the other activities of the Centres in connection with design of appliances and co-operation with manufacturers of equipment; in fact, many new loads may be expected through apparatus sold and installed directly by the manufacturers. As an example of this I can quote the case of the "Thermspray" boiler which was designed by the G.L.C. Centre to develop an entirely new load for gas. The bakery engineer responsible for its manufacture has already installed over one hundred on the areas of provincial undertakings.

Staffing and Organizing a Centre.

Collecting the right type of industrial staff has always presented a difficulty throughout the country—a fact which is easily accounted for, as it is necessary to cater for all types of inquiries and deal with fresh problems on which there is very little data available. It follows that the staff of a Centre must be really capable; otherwise the service which it can render to the contributing undertakings will be somewhat limited. It is quite a simple matter to work schemes out on paper, but they may become very unreal in practice if attention is not given to the staff before the Centre is organized.

My own view is that a Centre cannot be efficiently run unless it is definitely attached to an undertaking which has already organized a Section to deal with industrial matters. To have a representative running a Centre without any practical backing from the undertaking and without the resources which that undertaking has been able to collect over a number of years, makes it very difficult to work the scheme efficiently. Most of the Centres, however, are based on existing Industrial Departments and do possess a demonstration showroom and a staff to handle matters.

The size of the organization forming a Centre rather depends on the number of contributing undertakings attached to it, but for efficient working, even on the smallest scale, the personnel must consist of a designer, a chemist, and a draughtsman, with accommodation for a demonstration showroom and development workshop. It is essential that the personnel should realize that they are engaged to assist in the sale of gas; otherwise there is a possibility that all kinds of complications may arise and that instead of becoming a Section interested in the sale of gas, they will tend to develop into manufacturers competing with the existing suppliers of industrial equipment and driving them into the adoption of alternative fuels in the design of their appliances. I am sure you will agree that this is the last thing for which a Centre or development workshop should be used.

(*To be continued.*)

The Design of Gas-Fired Water Heaters

With Special Reference to Heat Transfer

A Paper read before the London and Southern District Junior Gas Association, Nov. 23, 1934.

By T. G. NOBLE, B.A. (Oxon.), A.M.I.H.V.E., of the Gas Light and Coke Company

(*Continued from p. 687.*)

Effect on Design.

Translated into terms of appliance design these lead to the further conclusions,

(i) That other things being equal, high flue gas temperature—*i.e.*, minimum of excess air, gives the greatest heat transfer. This is a somewhat obvious deduction, mentioned chiefly to draw further attention to the need to avoid applying it fully for reasons previously discussed.

(ii) That high linear velocity of gases is desirable: the effect of baffler in flueways is sometimes explained erroneously even by the designers themselves, as due to the " retarding effect " they have. The velocity obtainable in practice is, of course, governed by the considerations mentioned elsewhere except when forced draught is employed.

(iii) That for maximum heat transfer by convection numerous flueways of small cross-sectional area are preferable to larger flueways of equivalent total cross-sectional area, for a given linear gas velocity or a given area of heating surface.

In practice, however, very small flueways must be used with discretion. The less the flueways are liable to corrosion (either owing to use of suitable material or absence of condensation, or to both) the more one is able to reduce the permissible minimum size of flueways (always assuming, of course, that they are not reduced so much as to affect combustion adversely). It will be noticed that a similar conclusion is arrived at on the direct basis of the idea of the relationship between skin friction and heat transfer, since the use of smaller tubes for the same area increases the skin friction, owing to the greater value of the ratio surface area/volume.

Effect of Scale.

We are now in a position to draw a diagram more general than that of fig. 2. Fig. 3 (based on McAdams[21]) illustrates the general case of heat transfer through the wall of a water heater partly scaled but for simplicity assumed to have a clean heating surface.

We have already seen that, over a wide range, variation in the thickness or material of the walls is unimportant so far as the total heat transfer is concerned. This applies also to the effect of the layer of scale which, after all, is in the earlier stages merely a thin layer of insulating material and is only deleterious if the surface conductance on the gas side is abnormally high or the layer of scale is allowed to become so thick that its conductance is reduced to a value comparable with that of the gas surface conductance. This is the reason why with normal gas water heaters (as distinct from boilers and evaporators) having controlled temperatures (up to about 160° F.), and hence forming relatively thin layers of scale between normal maintenance periods, the efficiency is not found to rise appreciably after de-scaling. I am not, of course, advocating a cessation of de-scaling activities; they are necessary from time to time to prevent ultimate decrease in heat transfer, overheating of metal, and danger of burning sheet metal and cracking castings if thick layers of scale are allowed to accumulate.

While information on the factors affecting the scaling of hot, as distinct from boiling, water appliances is incomplete, attention should be paid to the following points affecting the design of water heaters intended for use in hard or moderately hard water districts if maintenance costs are to be kept low:

(1) Overheating must be avoided—this is generally recognized so far as " bulk temperature " is concerned, but the effect of intense local overheating giving localized deposits is sometimes ignored.

(2) Smooth and vertical heating surfaces are less liable to scaling than rough and horizontal surfaces.

(3) High water velocity tends to reduce scale deposition (though not, of course, formation). The rate of flow is controlled by various well-known factors, but so far as is consistent with these waterways should be kept small in cross-sectional area.

(4) Although there are many effective scale removing preparations on the market, mechanical removal of scale has some merits. While I do not think that it is desirable to design all appliances so that chemical de-scaling is unnecessary, there are obvious advantages in providing means of partial direct access to the interior, if only for visual inspection, whenever possible, especially in appliances used for the preparation of high-temperature (boiling) water or steam.

Effect of Corroded Flue-ways on Efficiency.

It may not be inappropriate in this section to refer to a misstatement which is sometimes made, more particularly

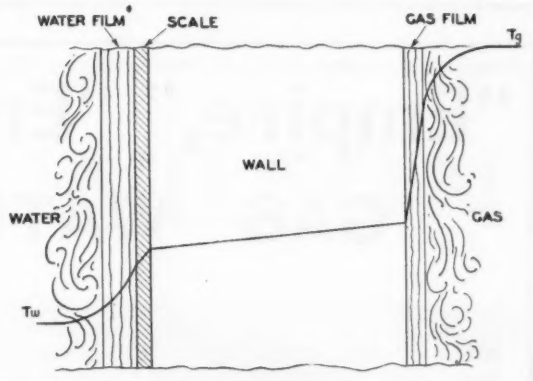

FIG. 3.

by our competitors, to the effect that the high initial efficiency of gas-fired appliances must necessarily decrease as flueways become corroded. This statement is theoretically unsound—for the reasons given earlier—and is contrary to my own experience. The effect of corrosion deposits is to reduce (not always seriously) the total amount of air passing through the flueways, and in doing so usually to *increase* the efficiency. The ill-effects of such deposits on combustion have been indicated already.

Surface Treatment.

There remains to discuss what methods are available for increasing the vital gas surface conductance. The most obvious is to increase the roughness of the surface, since, if the skin friction analogy is completely true, the increased skin friction should correspond to increased heat transfer. Investigation shows that some discrimination is needed here, as the effect of roughness on the fluid motion cannot always be calculated, but in general

the expected result follows. Care must be taken to see that the roughening is not so great that frictional resistance to flow causes bad combustion to result and that the roughnesses are not of such a type that dead spaces of cooled gas can be formed. There would appear to be an optimum depth of grooving, for example, or of horizontal finning, increase in which would result in the phenomenon mentioned. Fig. 4 is intended to illustrate this.

As already explained, there is no advantage in roughening the water side. The value of the optimum depth is

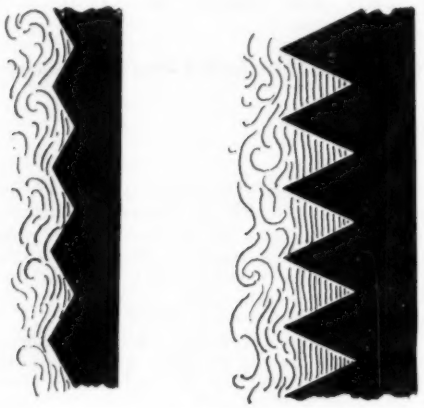

FIG. 1.

uncertain. The only evidence I have been able to find is that given in references [42] [16] and no final conclusions can be drawn at present.

The higher the velocity, the greater the depth of roughness allowable, since air trapped in recesses at low speeds may well be swept out at higher velocities. This would lead to a rather higher power of V than $V^{0.8}$ for the effect of velocity on rate of transmission. For this there is some experimental evidence in the papers referred to. Further information on this point would be of great interest, although it must always be borne in mind that maintenance of an appliance is simpler if the heating surfaces are smooth or nearly so, since corrosion deposits will tend to lodge less and when lodged are more easily removed from a smooth than from a rough surface. In any case the attainable velocities in most gas appliances are limited by natural draught considerations.

Fins, ribs, nibs, pips, or other projections on heating surfaces are common examples of the methods employed for increasing turbulence of the hot gases and are of proved value in increasing the overall heat transmission.

Fig. 5, which is purely hypothetical, illustrates a possible mechanism of flow round an isolated pip, showing the decreased thickness of the stagnant film round the lower half of the pip, against which the gas stream impinges directly. Such pips are advantageously staggered to give the maximum turbulence effect in two planes. Pips on the surfaces of narrow flueways are preferably asymmetrically disposed in a vertical plane to avoid very narrow spaces where deposits can collect. Such devices also increase the actual heating surface available for convection, the effect being particularly marked where numerous deep fins are used to increase the heat transfer to tubes of very small net surface area, as in the conventional German geyser construction now being widely adopted in this country.

Streamline Tubes, Pips, &c.

There is one very interesting example of the danger of assuming that decrease in turbulence necessarily implies decreased heat transfer. It has been found in the course of aeronautical research[48] that a streamlined tube gives a greater heat transfer than a tube of circular cross-section having the same surface area, when both are normal to the direction of flow of the heating or cooling gas stream. The suggested explanation is that the gas stream follows the surface of the streamlined tube more closely—the turbulence behind the circular tube being relatively useless. Thus, with the streamlined tube a greater proportion of the total resistance is due to skin friction, which is the source of resistance important in heat transfer. An increase in heat transfer of the order of 10% has been observed for

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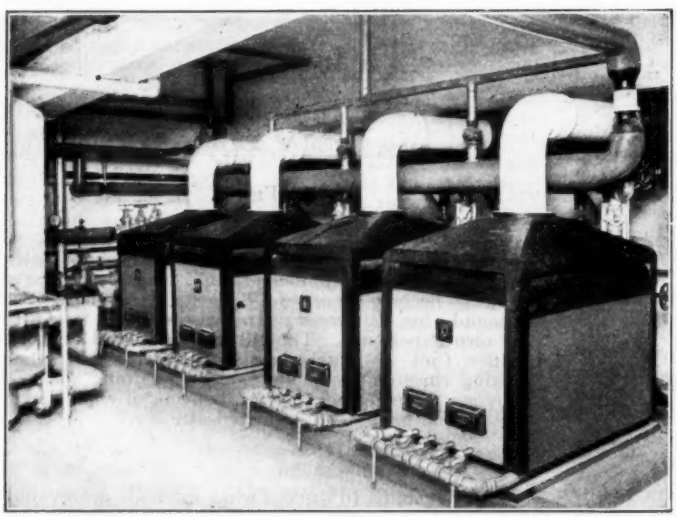

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velocities of the order of 10 ft. per second, comparable to those found in some gas appliances.

So far as I am aware this effect has not consciously been applied to the design of water heaters, but it appears worthy of investigation. Streamline tubes in cast metal are no more difficult to manufacture than circular, and it is probable that they could be embodied in existing designs of

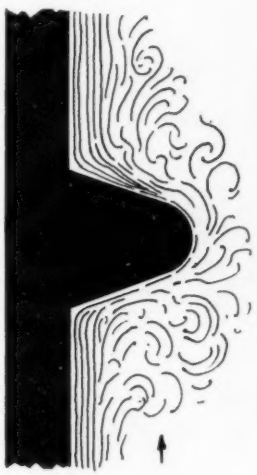

FIG. 5.

central heating unit with some advantage. It is possible, also, that improved overall conductances—*i.e.*, higher efficiencies, or for a given efficiency, smaller heating surfaces—could be obtained, and resistance to flue gas flow reduced, by the use of streamline pips or nibs in place of those of circular section employed in some cast heating units. Similar remarks apply to the design of the pips in other appliances—*e.g.*, gas fires and industrial furnaces—though, so far as I am aware, no direct experimental evidence is available. The effect is likely to be more marked in the heat-exchange tubes of unit air heaters for factories or plenum systems; with such units higher velocities are possible and the advantages of the reduced pressure loss are obvious.

Baffle Design.

The alternative method is to use a baffle in the flueways to create turbulence (and incidentally to transfer some heat to the wall by " solid " radiation). There is no general method of calculating the effect of these, which must usually be obtained by experiment, using past experience as a guide. In passing, one may mention a conviction that many of the baffles employed in gas appliances are quite unnecessarily complicated in design.

The object in designing the flue baffle should be to create a maximum of *useful* turbulence—*i.e.*, turbulence at the heating surface. Any baffle must represent an added resistance to gas flow through the appliance, and this resistance must not be allowed to become so great that combustion is impaired. Provided this requirement is met, there is no objection to a baffle of relatively high resistance, but nothing is gained unless the resistance is mainly due to *useful* turbulence as above defined.

In addition to causing local turbulences, baffles may be used as a means merely of giving a high surface-linear velocity to the flue gas. Theoretically this type, which is usually simple in form, would give best results if the annular or other space provided for gas flow decreased in area of cross-section proportionately to the decrease in volume of gases with decrease in temperature from bottom to top of the flueway.* For practical reasons such a shape is not adopted, but a tapering cone is a sufficiently good approximation, relatively easily constructed.

[The Bibliography to which numeral reference is made by the author will be published at the end of his paper.]

* The same remark applies, of course, to an unbaffled flueway.

(To be continued.)

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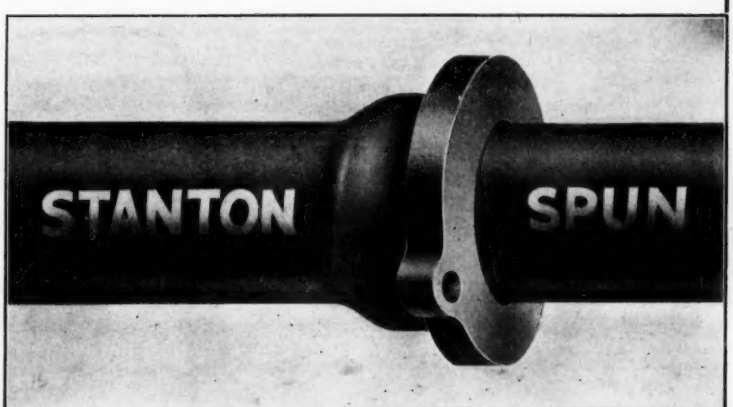

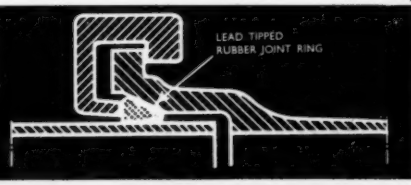

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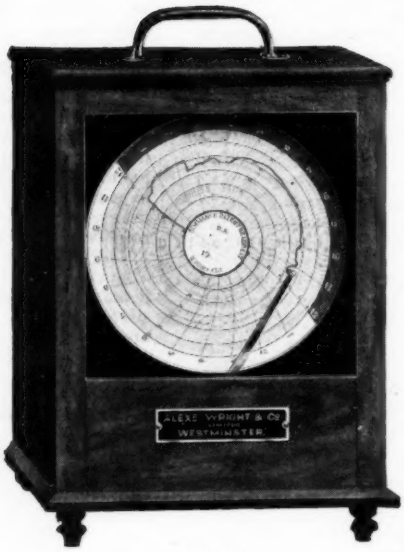

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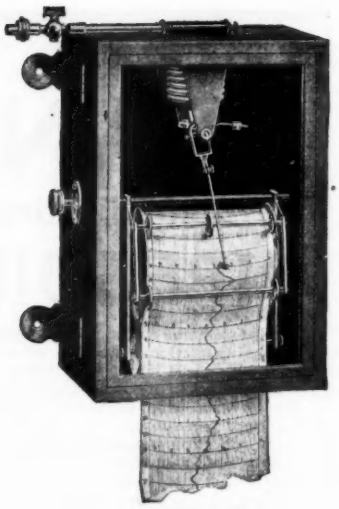

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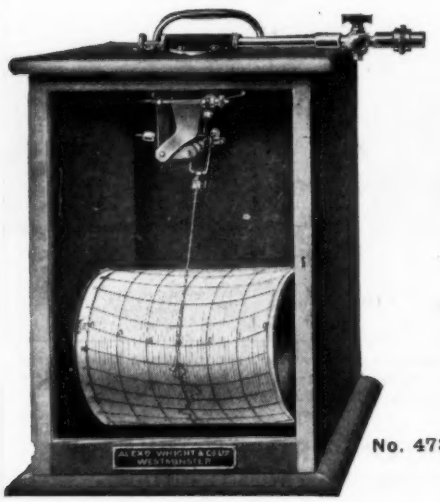

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Gas Markets and Manufactures

Stock Market Report.

[For Stock and Share List, see later page.]

Business on the Stock Exchange last week was on a reduced scale, though the general undertone remained firm. The profit-taking in British Funds eased off towards the close and the upward price movement was resumed. A feature of the week was the Birmingham £5,000,000 loan, which it will be remembered was a 2¾% stock offered at 96½, but it was unfortunate that the issued appeared during the period of the brief set-back in gilt-edged securities, the result being that over 74% was left with the underwriters. Dealings in the new stock opened at 10s. discount, improving later to 7s. 6d. premium. The Industrial market was patchy, and has not yet recovered from the weakness brought about by the former reaction in the gilt-edged section. Home rails revived by the announcement that the London Midland and Scottish Railway is to make up the dividend on the 5% redeemable preference stock (1955) to the full amount.

The volume of business in Gas stocks and shares also eased up, and a halt was called to the large number of appreciations in value which has been a feature during the past few weeks. There were a few rises, however, and these included one of 9 points in North Middlesex consolidated to 172½, and 4 points each in South Suburban ordinary and Newport (Mon.) 5% maximum, the latter on the Bristol Exchange. On the other hand, Gas Light units eased 6d. to 28s. 9d., and Imperial Continental 5½ to 212.

At the time of writing there is a fairly well-spread list of ordinary stocks available, including those of nearly all the London and Suburban Companies and also the following: £600 Harrogate 6% maximum at 145, yielding £4 2s. 8d.%; £340 North Middlesex 6% (7½% dividend) at 175, yielding £4 5s. 8d.%; 25,000 Severn Valley new £1 ordinary shares at 22s. 6d., free of expense, which gives a return on a 5% dividend basis of £4 8s. 10d.%; 1,000 South Eastern Gas Corporation £1 shares at 32s. 6d., yielding £3 13s. 10d.% and £1,050 South Shields consolidated giving a return of £4 10s. 5d.% assuming the maintenance of an 8½% dividend.

Another new issue relates to the Barnet District Gas and Water Company. The Directors are inviting tenders for £25,000 4½% preference stock at a minimum price of £114%, at which price the yield is £3 18s. 11d.%.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Dec.* 3.

Business in tar products has been quiet during the past week and prices are as follows:

Pitch, 48s. to 49s. per ton f.o.b.

Creosote is firm at 4½d.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole, about 2s. 2d.; pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 7d.; and 90/160 pyridine, 6s. to 6s. 3d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 3.

The average prices of gas-works products during the week were: Gas-works tar, 21s. 6d. to 26s. 6d.; Pitch—East Coast, 47s. 6d. to 50s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 47s. 6d. to 50s.* Toluole, naked, North, 1s. 6d. to 1s. 8d. Coal-tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4½d. Heavy naphtha, North, 9¾d. to 10¾d. Creosote, *ex* works, in bulk, North, liquid and salty, 3½d. to 3⅝d.; low gravity, 3½d. to 3⅝d.; Scotland, 3⅝d. to 3¾d. Heavy oils in bulk, North, 3⅝d. to 4¼d. Carbolic acid, 60's, 1s. 8d. to 1s. 9d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Dec.* 1.

Prices are well maintained, although new business continues rather scarce.

Crude gas-works tar.—Actual value is 30s. to 32s. per ton *ex* works in bulk.

Pitch.—Quotations are unaltered at 43s. to 44s. per ton f.o.b. Glasgow for export and 42s. 6d. per ton *ex* works in bulk for home trade.

Refined tar is offered freely at 3d. to 3½d. per gallon f.o.r. naked.

Creosote oil.—Values of all grades are steady. B.E.S.A. Specification, 3¾d. to 4d. per gallon; low gravity, 4¼d. to 4½d. per gallon; and neutral oil, 4d. to 4¼d. per gallon; all f.o.r. in bulk.

Cresylic acid.—While fresh business is not plentiful, makers are maintaining quotations. Pale, 97/99%, is 1s. 2½d. to 1s. 3½d. per gallon; dark, 97/99%, 1s. 0½d. to 1s. 1½d. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 5d. per gallon; all *ex* works.

Crude naphtha is still steady at 4½d. to 5d. per gallon f.o.r., according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 3d. to 1s. 4d. per gallon, and 90/190 grade is round 8d. to 9d. per gallon, according to quantity.

Motor benzole.—1s. 5d. per gallon (nominal).

Pyridines.—90/160 grade is 6s. to 6s. 6d. per gallon, and 90/140 grade 6s. 6d. to 7s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole . . .	0 9	to	0 9½	per gallon at works
Motor ,, . . .	1 3½	,,	1 4	,, ,, ,,
90% ,, . . .	1 4	,,	1 4½	,, ,, ,,
Pure ,, . . .	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day.

Carbonizing Plant.

Milford Haven Gas and Water Department. [p. 772.]

Gasholder, Tank, and Foundations.

Mansfield Gas Department. [p. 770.]

Meters.

Stockport Gas Department. [p. 772.]

Oils (Lubricating).

Carlisle Gas Department. [p. 772.]

Pipes and Specials, &c.

Mansfield Gas Department. [p. 770.]

Tar.

Carlisle Gas Department. [p. 772.]

Trade Notes.

"Pyruma" Fire Cement.

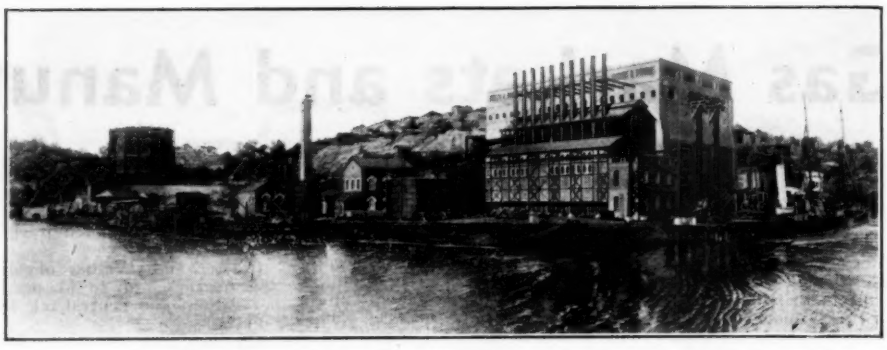
We have received from Messrs. J. H. Sankey & Son, Ltd., a specimen of their recently published "Pyruma" Fire Cement Catalogue. It is a noteworthy fact that to-day over 5,000 industrial heat consumers of all kinds regularly use "Pyruma." There are fourteen different grades of fire cements manufactured by this firm.

Gas Undertakings' Results.

Teignmouth.

The annual report of the Teignmouth Gas Department for the year ended March 31, 1934, states that the gross profit for the year was £5,909. The interest on capital and repayment of capital required £4,156 and income-tax was £770. This left a balance of £983, which is carried forward to the credit balance, making this now £5,114. The net income of the Department for the year was £25,871 and the net expenditure £24,887. The price of gas remained the same during the year; the rebates given to the consumers being £1,642, against £1,570 last year. The total gas sold was 88,179,400 c.ft. or 396,807·75 therms, an increase of 1·3% on last year. The number of consumers increased by 76 to a total of 2,702. Residuals realized over £3,404, while the sales of appliances amounted to £2,282. The public lighting revenue increased by £38. The number of public lamps was increased by 15 and now totals 418. The coal carbonized was 5,484 tons and the gas made was 81,288,000 c.ft., to which was added 10,720,000 c.ft. of carburetted water gas made from 326 tons of coke and 12,552 gallons of oil.

The installation of Glover-West vertical retorts at the works of the North Shore Gas Company of Sydney, N.S.W.



Another repeat order for West's carbonizing plant

From the North Shore Gas Company of Sydney, New South Wales, we have received a contract for an installation of Westvertical carbonizing chambers with an estimated daily capacity of 3 million cubic feet. The new unit will augment the present Glover-West vertical retort plant at the North Shore works, and both will be served by an extensive new coal and coke handling plant.

WEST'S CARBONIZING & FUEL-HANDLING SYSTEMS

GLOVER-WEST VERTICAL RETORTS . . . . . WESTVERTICAL CARBONIZING CHAMBERS

THE WEST LIP-BUCKET CONVEYOR WITH AUTOMATIC FORCED LUBRICATION . . . ALL TYPES OF CONVEYORS, ELEVATORS AND SKIP-HOISTS . . . COKE CRADERS . . . BREEZE-BURNING PRODUCER EQUIPMENT . . . ETC., ETC.

WEST'S GAS IMPROVEMENT CO., LTD.

LONDON: REGENT HOUSE, KINGSWAY, W.C. 2
'PHONE: HOLBORN 4108. 'GRAMS: "IMVERTRET, WESTCENT."

MANCHESTER: MILES PLATTING, MANCHESTER, 10
'PHONE: COLLYHURST 2961. 'GRAMS: "STOKER, MANCHESTER"

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Nov. 30.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Sept 10	7	7	Alliance & Dublin Ord. ...	135—145	...	138½
374,000	"	June 25	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
557,655	"	Aug. 13	7	7	Barnet Ord. 7 p.c.	168—173	...	...
800,000	1	Oct. 8	1/9‡	1/4‡	Bombay, Ltd.	1⅛—1⅛	...	...
178,480	Stk.	Aug. 13	9½	9½	Bournemouth sliding scale	225—235	...	...
550,050	"	"	7	7	Do. 7 p.c. max. ...	170—175	...	172½
439,160	"	"	6	6	Do. 6 p.c. Pref. ...	150—155	...	...
50,000	"	June 11	3	3	Do. 3 p.c. Deb. ...	87—92	...	...
262,025	"	"	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	"	"	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
357,900	"	Aug. 13	7½	7½	Brighton, &c., 6 p.c. Con. ...	175—185	...	...
540,000	"	"	6⅔	6⅔	Do. 6 p.c. Con. ...	158—163	...	...
195,500	"	"	6	6	Do. 6 p.c. B. Pref.	145—150	...	...
1,487,500	"	July 9	5	5	Bristol 5 p.c. max.	120—122*a*	...	...
190,420	"	June 11	4	4	Do. 1st 4 p.c. Deb. ...	103—106*a*	...	...
317,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	103—106*a*	...	...
333,790	"	"	5	5	Do. 5 p.c. Deb.	123—125*a*	...	...
855,000	"	Sept. 24	8	7	British Ord.	170—175	...	176—177½
100,000	"	June 11	7	7	Do. 7 p.c. Pref.	158—163	...	...
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	98—103	...	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	110—115	+3	112
100,000	10	22 May '33	6	4	Cape Town, Ltd.	2—4	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	4—6	...	...
150,000	Stk.	July 23	4½	4½	Do. 4½ p.c. Deb. ...	90—95	...	...
626,860	"	July 23	6	6	Cardiff Con. Ord.	135—140	...	...
287,860	"	June 11	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
157,150	"	July 23	5⅛	5	Chester 5 p.c. Ord.	118—118*b*	...	...
98,986	1	Sept. 24	2/-	2/-	Colombo, Ltd. Ord.	1⅞—1⅞	...	...
24,500	1	"	1/4½	1/4½	Do. 7 p.c. Pref. ...	19/6—21/6	...	...
609,204	1	Sept. 24	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	21/6—21/9
296,058	1	"	1/8'80	1/8'80	Do. 8 p.c. Pref.	24/6—26/6	...	25/9—26/-
1,775,005	Stk.	July 23	6⅔	5	Commercial Ord.	122—127	...	125—125½
475,000	"	June 11	3	3	Do. 3 p.c. Deb. ...	88—92	...	...
286,344	"	Aug. 13	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
807,560	"	Aug. 13	7	7	Croydon sliding scale ...	165—170	...	...
569,590	"	"	5	5	Do. max. div. ...	112—117	...	...
620,385	"	June 25	5	5	Do. 5 p.c. Deb.... ...	128—128	...	...
542,270	"	Aug. 13	10	7	Derby Con.	195—205*e*	+3	...
55,000	"	June 25	4	4	Do. 4 p.c. Deb.	100—105*e*	...	...
209,000	"	Aug. 13	5	5	East Hull Ord. 5 p.c. ...	113—118	...	117½
181,625	"	Aug. 13	6	6	East Surrey Ord. 5 p.c. ...	137—142	...	...
175,609	"	June 11	5	5	Do. 5 p.c. Deb. ...	120—125	...	...
1,002,180	"	Sept 10	17	15	European, Ltd.	122—127	...	122—123
19,342,768	"	Aug. 13	5⅞	5⅞	Gas Light & Coke 4 p.c. Ord.	28/3—29/3*f*	—/6	28/6—29/3
2,600,000	"	"	3½	3½	Do. 3½ p.c. max.	93—96	...	94—95⅝
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	108—111	...	109—111
6,102,497	"	May 28	3	3	Do. 3 p.c. Con. Deb. ...	89—92	...	89½—92
3,643,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	118—121	...	120—121
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	117—120	...	119—119½
270,466	"	Aug. 13	6	6	Harrogate New Cons. ...	140—145	...	...
140,000	1	Sept 24	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅜—1⅜	...	...
213,200	Stk.	Aug. 13	6	6	Hornsey Con. 3½ p.c. ...	137—142	...	...
5,600,000	"	Oct. 22	14	10	Imperial Continental Cap.	207—217	—5½	206—217
223,180	"	July 23	3½	3½	Do. 3½ p.c. Red. Deb.	92—97	...	...
285,242	"	Aug. 13	8½	8½	Lea Bridge 5 p.c. Ord. ...	196—200	...	196
2,167,410	"	Aug. 13	6	6	Liverpool 5 p.c. Ord. ...	140½—142½*b*	+½	...
245,500	"	June 11	5	5	Do 5 p.c. Red. Pref. ...	105—110*b*	...	...
306,083	"	July 16	4	4	Do. 4 p.c. Deb. ...	102—104*b*	...	...
11,751	"	Aug. 27	10	8	Maidstone 5 p.c. Cap. ..	188—198	...	...
63,480	"	June 25	3	3	Do. 3 p.c. Deb. ...	84—89	...	...
75,000	"	May 28	†10	†10	Malta & Mediterranean ...	200—210	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—103	...	...
251,978	Stk.	Aug. 13	5	5	M. S. Utility "C." Cons. ...	113—118	...	...
818,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	100—105	...	...
360,075	"	June 11	4	4	Do. 4 p.c. Deb. ...	102—107	...	...
148,955	"	"	5	†5	Do. 5 p.c. Deb. ...	122—127	...	...
125,000	—	July 2	...	11/8	Do. 3½ p.c. Rd. Rg.Bds.	97—100	...	...
675,000	"	May 28	†6	†3	Montevideo, Ltd.	60—65	...	60
2,061,315	"	Aug. 13	6⅔	6	Newcastle & Gateshead Con.	25/9—26/9*d*/	...	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	105—107*d*	...	...
776,706	"	June 11	3½	3½	Do. 3½ p.c. Deb. ...	100—102	...	...
277,285	"	May 7	5	5	Do. 5 p.c. Deb. '48 ...	105—107*d*	...	...
274,000	"	Aug. 13	5	5	Newport (Mon.) 5 p.c. max.	110—112*a*	+4	...
204,940	"	Aug. 13	7½	7½	North Middlesex 6 p.c. Con.	170—175	+9	170
396,160	"	Aug. 13	5	5	Northampton 5 p.c. max. ...	107—112	...	...
300,000	"	Nov. 5	†7	†9	Oriental, Ltd.	166—171	...	171
416,617	"	June 11	8	8	Plym'th & Stonehouse 5 p.c.	183—188	...	187
504,416	"	Aug. 13	8	8	Portsm'th Con.Stk. 4 p.c.Std	182—187	...	...
241,446	"	"	5	5	Do. 5 p.c. max. ...	110—115	...	...
114,000	"	July 23	5	5	Preston 5 p.c. Pref.	101—105	...	...
1,736,968	Stk.	Aug. 27	6	6	Sheffield Cons.	141—143*e*	...	...
95,000	"	July 9	4	4	Do. 4 p.c. Deb.	100—104*e*	...	...
133,201	"	Aug. 13	5	8½	Shrewsbury 5 p.c. Ord. ...	154—159	...	155½
90,000	10	May 28	†4	†3	South African	3—4	...	3¾
927,177	1	Sep. 10	1/2‡	1/2‡	South East'n Gas Cn.Ld Ord.	3'/6—32/6	...	31/6—32/3
736,061	1	"	-/10‡	-/10‡	Do. 4½ p c. Red.Cn.m.Pref.	22/6—23/6	...	...
450,000	Stk.	Aug. 13	7¼/4	4	Do. 4 p.c. Red. Deb. ...	102—105	...	...
6,709,895	"	Aug 13	7	5	South Met. Ord.	153—178	...	153—165½
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	148—153	...	151—154½
850,000	"	"	4	4	Do. 4 p.c. Irred. Pf.	107—110	...	108½—109½
1,895,445	"	June 25	3	3	Do. 3 p.c. Deb ...	90—93	...	91½—92
1,000,000	"	July 9	5	5	Do. 5 p.c. Red. Deb.	117—121	...	120¾
209,820	"	Aug. 13	8½	8½	South Shields Con.	185—187*d*	+2	...
1,548,795	"	July 9	6	6	South Suburban Ord. 5 p.c.	144—149	+4	147—149
512,825	"	"	5	5	Do. 5 p.c. Pref.	124—129	...	125—127½
300,000	"	"	4	4	Do. 4 p.c. Pref.	102—107	...	...
868,837	"	June 11	5	5	Do. 5 p.c. Deb.	125—130	...	...
100,000	"	"	4	4	Do. 4 p.c. Deb.	108—113	...	112½
647,740	"	Aug. 13	5	5	Southampt'n Ord. 5 p.c. max.	118—123	...	...
121,275	"	June 11	4	4	Do. 4 p.c. Deb.	102—107	...	...
350,000	"	Aug. 13	5½	5½	Swansea 5½ p.c. Red. Pref.	113—118	...	...
200,000	"	June 11	6½	6½	Do. 6½ p.c. Red. Deb.	102—107	...	105—106½
1,076,490	"	Aug. 13	6⅔	6⅔	Tottenham and District Ord.	163—168	...	163—166⅔
409,835	"	"	5⅓	5½	Do. 5½ p.c. Pref. ...	130—135	...	134½
62,235	"	"	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
199,005	"	June 11	4	4	Do. 4 p.c. Deb. ...	102—107	...	...
349,110	"	Aug. 13	7	7	Uxbridge, &c., 5 p.c. ...	165—170	...	...
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	124—129	...	...
1,326,700	"	Aug. 13	7	7	Wandsworth Consolidated	165—170	...	166½—170
1,371,373	"	"	5	5	Do. 5 p.c. Pref.	124—129	...	126
1,317,964	"	June 11	5	5	Do. 5 p.c. Deb.	125—130	...	128
209,300	"	"	...	26/8	Do. 4 p.c. Deb.	107—110	...	...
158,400	"	Aug. 13	6*g*	5	Winchester W.& G.5 p.c.Con.	120—125	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g.*—Paid £8, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

COMPANY NOTICES.

THE GAS LIGHT AND COKE COMPANY.

NOTICE is Hereby Given that the TRANSFER BOOKS of this Company, so far as they relate to DEBENTURE STOCKS, WILL BE CLOSED at Four o'clock p.m. on Monday, the 10th proximo, for the half-year ending on the 31st proximo, and will be RE-OPENED on the morning of Tuesday, the 11th proximo.

The Interest for the half-year will be remitted by Warrant forwarded by post on the 31st December next to the Proprietors registered on the Closing of the Books or their authorized Agents.

By order,
WILLIAM LYLE GALBRAITH,
Secretary.

Chief Office:
Horseferry Road,
Westminster, S.W. 1,
Nov. 28, 1934.

WINCHESTER WATER AND GAS COMPANY.

NOTICE is Hereby Given that the 4 PER CENT. and 5 PER CENT. IRREDEEMABLE DEBENTURE STOCK REGISTERS WILL BE CLOSED from the 20th day of December, 1934, to the 31st day of December, 1934, both days inclusive.

By order of the Board,
W. D. WALKER,
Secretary.

90, High Street,
Winchester,
Dec. 5, 1934.

UXBRIDGE, MAIDENHEAD, WYCOMBE, AND DISTRICT GAS COMPANY.

NOTICE is Hereby Given that the DEBENTURE TRANSFER BOOKS WILL BE CLOSED from the 17th to the 31st December, both days inclusive, and the Interest Warrants will be paid on the 1st January next to the Debenture Holders registered at the date of closing.

By order of the Board,
GEORGE J. BRISTOW.

Dec. 4, 1934.

EDUCATIONAL.

THE INSTITUTION OF CHEMICAL ENGINEERS.

EXAMINATION, 1935.

APPLICATION Forms (returnable 20th December, 1934) and Particulars of the Associate-Membership Examination for 1935, together with the Memorandum on "The Training of a Chemical Engineer," may be obtained from the HON. REGISTRAR, INSTITUTION OF CHEMICAL ENGINEERS, ABBEY HOUSE, WESTMINSTER, LONDON, S.W. 1.

AUTHORITATIVE TRAINING FOR GAS ENGINEERS

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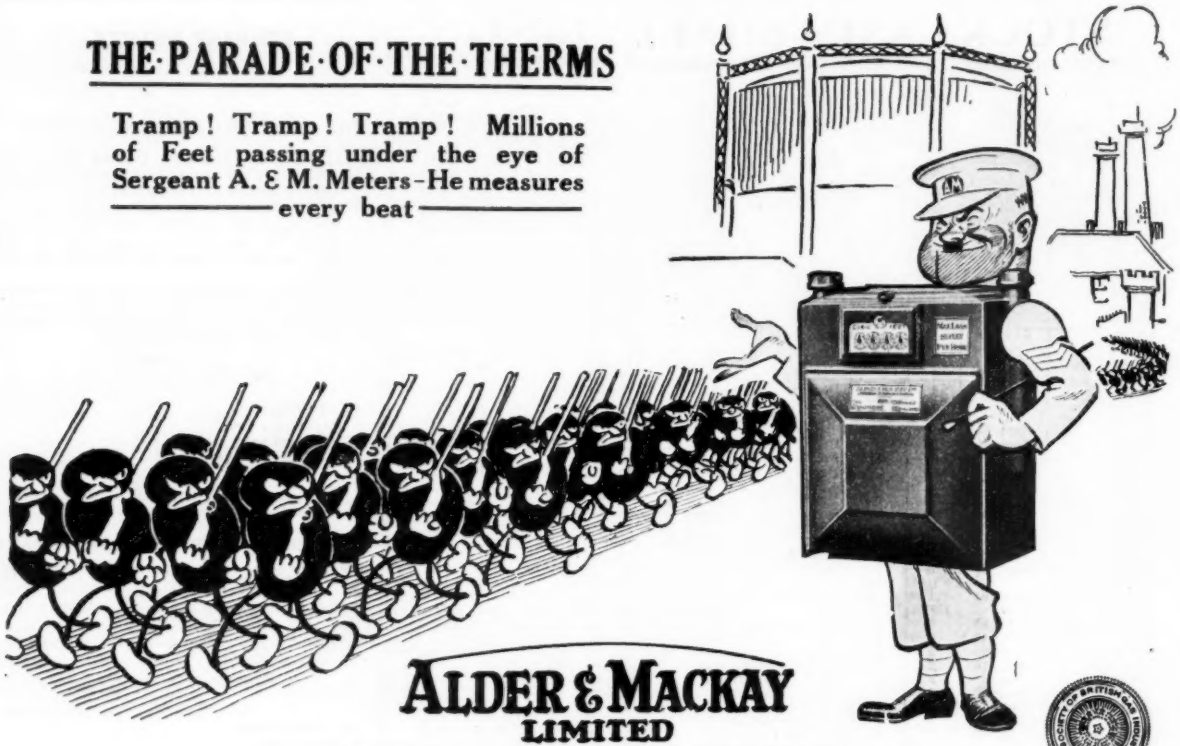
THE·PARADE·OF·THE·THERMS

Tramp! Tramp! Tramp! Millions of Feet passing under the eye of Sergeant A. & M. Meters–He measures every beat



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MAKE METERS OF METICULOUS MEASUREMENT

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AND ENSURE A SUPPLY

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